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A
TREATISE
ON THE CULTURE OF THE
APPLE & PEAR,
AND ON THE
MANUFACTURE
OF
CIDER & PERRY.

By T. A. KNIGHT, Esq.

SECOND EDITION, ENLARGED.

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THE effects of cultivation on the animal and vegetable systems are extremely similar. A change in form, in colour, and in size or stature, takes place in each; and in each those changes appear to arise from similar causes—from a more abundant and regular supply of nourishment than is afforded in a state of nature, with a favourable climate, or protection from the bad effects of an indifferent one. The offspring of every plant and animal, when unchanged by cultivation, bears a very close resemblance to it's parents; but amongst the cultivated kinds of each, it is extremely various; still, however, generally shewing some similarity to them. By taking advantage of incidental variations, and by propagating from those individuals which approach nearest to our ideas of perfection, improved varieties of fruit, as well as of animals, are obtained. Much attention has in the present day been paid to the improvement of the latter, whilst the former have been almost entirely neglected: probably from an opinion that these, being natives of warmer climates, of necessity degenerate in this. This opinion is however unfounded; a more favourable climate would no doubt be advantageous to every plant and animal; but the stall and meadow counter-balance the defects of our climate in the improvement of the one, and it is probable that the south wall and highly manured border will have the same good effects in the other, and that the changes produced in each will be in proportion to the skill and industry of the cultivator.

The Apple (on the culture of which I propose to offer some observations in the following pages) is not the natural produce of any soil, or climate; but owes its existence to human art and industry; and differs from the crab, which is a native of every part of England, only in the changes which cultivation has produced in it. The first varieties which were cultivated in England, were no doubt imported from the continent; but at what period is not, I believe, known. Many were introduced by a fruiterer of Henry the eighth, and some at subsequent periods; but I am inclined to think that we are indebted to the industry of the planters of the early part of the last, and the end of the preceding century, for most of those we have at present, and probably for all the old fine cider fruits. Of these they have left us a sufficient number; but the existence of every variety of this fruit, appears to be confined to a certain period, during the earlier parts of which only, it can be propagated with advantage to the planter. No kind of apple, now cultivated, appears to have existed more than two hundred years; and this term does not at all exceed the duration of a healthy tree, or of an orchard when grafted on crab-stocks, and planted in a strong tenacious soil. From the description Parkinson, who wrote in 1629, has given of the apples cultivated in his time, it is evident that those now known by the same names are different, and probably new varieties; and though many of those mentioned by Evelyn, who wrote between thirty and forty years later, still remain, they appear no longer to deserve the attention of the planter. The Moil, and its successful rival the Redstreak, with the Musts and Golden Pippin, are in the last stage of the decay, and the Stire and Foxwhelp are hastening rapidly after them.

In the propagation of animals we can obtain a succession of offspring produced only according to the usual course of nature; because an animal forms a whole, whose parts cannot retain life, when separated from each other. The less complex, and less elaborate, organization of vegetables admits of other modes of propagation; and a detached part of each individual is capable of forming a plant in every respect similar to that from which it was taken, and possessed of all its powers and properties. Vegetable, however, like animal life, in individuals, appears to have its limits fixed by nature, and immortality has alike been denied to the Oak, and to the Mushroom; to the being of a few days, and of as many centuries. The general law of nature must be obeyed, and each must yield its place to a successor. The art of the planter readily divides a single tree into almost any number that he wishes; but the character of the new trees, thus raised, is very essentially different from that of a young seedling plant; they possess a preter-natural maturity, and retain the habits and diseases of the tree of which they naturally formed a part.

All efforts, which have hitherto been made to propagate healthy trees of those varieties which have been long in cultivation, have, I believe, been entirely unsuccessful. The grafts grow well for two or three years, after which they become cankered and mossy, and appear, what I consider them really to be, parts of the bearing branches of old diseased trees.

When I first observed the unhealthy state of all the young trees of these kinds, I suspected

I suspected that it arose from the use of diseased grafts taken from old trees; and that I should be able to propagate all the valuable varieties by buds taken from young newly grafted trees, as these can scarcely be said to take any of the wood of the old stock with them: but to remove still farther every probability of defect which might be communicated from the old trees, I inserted the young shoots and buds taken from newly grafted trees in other young stocks, and I repeated this process six times in as many years, each year taking my grafts, and buds, from those inserted in the year preceding. Stocks of different kinds were also used; some were double grafted, others obtained from the branches of apple-trees which had emitted shoots from cuttings, and others from the seeds of each kind afterwards inserted in them, under the idea that there might be something congenial to the fruits in stocks of this kind. The grafts grew tolerably, and equally well in all; but there was always a want of hardness and elasticity in the wood,* and at the end of three or four years all began to canker. Several kinds of fruit were subjected to these trials; but principally the Redstreak and Golden Pippin, (particularly the latter) and as these had formerly grown well in the same soil, I began to suspect that their diseases arose from the debility of age, and would consequently be found incurable. The canker, however, which constitutes their most fatal disease, often arises from other causes. It is always found in those varieties which have been long in cultivation, and in these it annually becomes more destructive, and evidently arises from the age of the variety; but it often appears to be hereditary. A gravelly or wet soil, a cold preceding summer, or a high exposed situation, adds much to its virulence. It is most fatal to young free growing trees of old varieties, and I have often seen the strong shoots of these totally destroyed by it, when the old trees growing in the same orchard, and from which the grafts had been taken, were nearly free from the disease. The latter had ceased to grow larger, but continued to bear well, not being of very old kinds of fruit: the young stocks, by affording the grafts a preter-natural abundance of nourishment, seemed in this instance to have brought on the disease; and I have always found that transplanting, or a heavy crop of fruit, which checked the growth of the tree, diminished it's disposition to canker. In middle-aged trees of very old kinds a succession of young shoots is annually produced by the vigour of the stock, and destroyed again in the succeeding winter: the quantity of fruit these produce is in consequence very small. In this disease something more than a mere extinction of vegetable life appears to take place. The internal bark bears marks of something similar to erosion, and this, I believed formerly to be the original seat of the disease; but subsequent observation has satisfied me that the canker is a disease of the wood, and not of the bark. It does not appear to me to be ever a primary, or merely local disease, but to arise from the morbid habit of the plant, and to be incurable by any topical application.

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* There appears to be naturally a considerable difference in the hardness of the wood of different varieties of this fruit, and therefore softness in the wood must not always be considered as symptomatic of disease and decay.

Being, after much unsuccessful experience, satisfied that those varieties of the apple, of which the original trees had long perished from old age, could not be made to grow, I suspected that grafts, taken from very young seedling trees, not yet in a bearing state, could not by any means be made to produce fruit. Having taken cuttings from some of these of two years old, I inserted them in stocks of twenty years old, which had already produced fruit. I afterwards frequently transplanted, and took every means in my power to make them produce blossoms; but though they grew in rich ground, which probably tended to accelerate their maturity, I did not succeed 'till the seedling trees were twelve years old; and then other grafts of the same kind, which had been inserted but three years before, and the seedling trees themselves, readily blossomed. Other cuttings were inserted in very old stocks, which were regrafted; these grew with excessive vigour, but did not produce blossoms so soon as the others.

In these experiments I observed that the leaves of the young seedling plants annually changed their character, and became more thick and fleshy, assuming more the appearance of those of the old cultivated kinds. These external changes evidently indicated some internal ones in the constitution of the plant, which are probably similar, in their nature, to those which take place in animals between their infancy and the time when they become capable of propagating their species.

The periods, which seedling apple-trees require to attain sufficient maturity to produce fruit, appear to admit of more variation than my first experiments induced me to suppose. Some, which I raised, did not produce blossoms till they were sixteen years old; others have blossomed in the ninth and tenth year; and two plants in the present year, have produced fruit at only five years old: I consider these as very extraordinary instances of early maturity, as these two only have occurred in more than twenty thousand seedling trees that have come under my observation. The rapid change of character in the leaves of these plants attracted my observation when they were but two years old, and I then inserted grafts from one of them in older stocks. These did not blossom in the last spring; but the form and character of their buds already indicate, that they possess the habit and maturity of the tree from which they were taken, and that an abundant blossom is forming for the succeeding season. In this instance the grafts, which were inserted in older stocks, produce blossoms one year later than the seedling tree: in a few other instances the grafted trees have preceded the other a single year; but this has been the greatest variation I have yet observed; and the original tree, and the grafts taken from it, have most frequently produced their first blossoms in the same season.

From the result of these experiments, and from the general failure of every attempt to propagate every old variety of the apple,* I think I am justified in the conclusion that all plants of this species, however propagated from the same stock, partake in some degree of the same life, and will attend the progress of that life, in the habits of its youth, its maturity, and its decay; though they will not be any way affected by any incidental injuries the parent tree may sustain after they are detached from it. The roots however, and the trunk adjoining them, appear to possess in all trees a greater degree of durability, than the bearing branches, having a

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* The accuracy of my experiments has been questioned (in a very liberal and gentlemanlike manner however) in the Monthly Review, because the result of them did not agree with those of Mr Forsyth. In consequence of the doubts there expressed, and at the desire of Sir John Sinclair, then president of the Board of Agriculture, I went to Kensington to see the trees which had been the subject of Mr. Forsyth's experiments. I was shewn some St. Germain pear trees, whose branches had been taken off, and whose stems had been plaistered, which had

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had shot forth new branches with great vigour; but this variety of the pear is in its middle age, and free from debility and decay. Some trees of the golden pippin had been subjected to the same management; but in these it did not succeed, and I never saw that fruit in a lower state of debility and decay than at Kensington. The object of my present pursuit does not call on me to give any further opinion on the general merits of Mr. Forsyth's composition; but I must say that I do not place much confidence in any topical application to the wounds, or diseases, of vegetables power of producing new branches, when the old ones have been destroyed by accident, or even by old age: and I have found that grafts taken from scions, which have sprung out of the trunks of old ungrafted apple and pear trees, grew with much greater luxuriance than those taken, at the same time, from the extremities of the bearing branches. The former in their growth assumed the appearance of young seedling stocks, and the shoots of the pear were, like those, covered with thorns. Those propagated from the bearing branches frequently produced fruit the second year, but the others remained long unproductive.*

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* It appears to me extremely probable that such trees as the walnut, and mulberry, which do not produce fruit in less than twenty years, might be rendered fruitful in one third of that time, by being grafted with cuttings taken from the productive branches of an old tree. The walnut has not succeeded

Other grafts, which were taken from shoots out of the large boughs, of the pear-tree, in the intermediate space between the trunk and the bearing branches, partook, in their form of growth, of the character of each of the foregoing kinds, producing a much smaller quantity of thorns than the one; but not being entirely free from them, like the other. Whence it appears to follow that there is a progressive change from the roots to the extremities of the bearing branches, and probably an increasing tendency to decay; for the life of every tree is known to be greatly prolonged, when its

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ceeded, in my hands, when grafted, unless by approach; but three seedling trees of one year old thus grafted in 1799 produced an abundant blossom this spring, and would, I have no doubt, have borne fruit; but that the blossoms, and young leaves were all destroyed together by the frost. I suspect that grafting by approach, or inarching, will be found the most successful and effectual method of transferring the habits of the bearing branch to the grafted tree.

branches are frequently taken off, and it is compelled to make use of the reserved buds with which nature has provided it: and I have not the least doubt but that, in the culture of the apple and pear, the life of each original tree might be prolonged, to three times its natural period, by robbing it of its branches, as soon as the qualities of its fruit were known, and retaining it as a pollard, or more properly in the state of the stools in a coppice, which is felled at regular periods: for these are known to possess a much greater degree of durability than the same kind of trees when left in the natural state, and to produce a vigorous succession of branches during many centuries. It is however probable that, after a certain period, each effort of nature will be inferior to the preceding; for timber trees, which have sprung from the stools of an old coppice, are always observed to attain a small stature, with an early maturity and decay.*

Should any valuable variety of the apple be retained in the state I have described, I would recommend that its branches be taken off every third or fourth year, and used for grafts, and that it never be suffered to fulfil the intentions of nature by producing either fruit, or blossoms: under this mode of treatment I have little doubt but that the same variety might be propagated through many centuries.

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* I believe this observation may be extended to every kind of tree, and that the Elm and Poplar, which are now propagated by layers and cuttings, would attain a much larger stature, if raised immediately from seed. The trees thus produced would have the advantages of a greater variety of form, and of tints in the spring and autumn foliage, which are always wanting in those raised from the same stock, and which constitute no small part of the beauty of forest trees.

It appears also probable that the latter period of the existence of the apple-tree would be considerably prolonged in a southern climate, for all the old kinds grow best in warm situations, and the most diseased flourished with the greatest vigour, when I trained them to a south wall. This mode of culture will not suit the cider-maker; but it may probably be adopted with much advantage, when new varieties are to be obtained from seed; and the production of these must be the first thing to engage the attention of the planter of the present day.

A few varieties of the apple are sufficient for the most extensive district, where the soil is of the same kind, and the situations equally warm; but a very numerous variety will be wanting to correct the defects of every different soil and aspect.

When the plantations on any farm are extensive, it will also be highly advantageous to the farmer that his fruit should become ready for the mill at different seasons. An apple, as early as the Juneating, would be ripe in July, and the cider this would afford, would soon pass through its fermentation, owing to the heat of the weather at that season, and be ready for use before the end of the corn harvest; when the same casks might be filled again with the produce of later fruits. If other fruits were planted, capable of being easily preserved through the winter,* the farmer might be able to fill the same casks a third time, or even more, should he have the good fortune to meet with as able assistants to empty them, as the labouring classes of Herefordshire generally are. As it

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* I have seen apples successfully preserved through winter, by being covered, as potatoes usually are, with mould and straw.

is also of more consequence to the farmer, and to the community, to have a moderate crop of fruit every season, than an abundant one with intervening failures, the plantation on each farm should consist of some fruits which blossom very early, and others extremely late. An attention to this point will amply repay any future planter; and fruits possessing the necessary qualities may be readily obtained. My nursery contains at present many plants, which will rarely be seen to blossom within a month of each other. The means by which these have been produced, I shall, in another place, point out.

The fruit liquors, for which the county of Hereford has long been celebrated, have always been supposed to derive their excellence from some peculiar quality in the soil which produces them. A preference has however been given to soils of opposite kinds by the planters of different ages. Those of the last century uniformly contended in favour of a light sandy loam, and on this their finest ciders were made: at present a soil of a diametrically opposite quality, a strong red clay is generally preferred. Much of the soil, however, which is called clay in Herefordshire, is properly argillaceous marl; and some of it contains a large portion of calcareous earth, and effervesces strongly with acids: I have found this soil to form the substratum of some orchards much celebrated for producing ciders of the first quality. It appears to have the effect of mitigating the harshness of rough austere fruits; and as the trees grow with great luxuriance in it, it is perhaps, of all soils, the best calculated to answer the wishes of the planter. But the strongest, and most highly flavoured liquor, which has hitherto been obtained from the apple, is produced by a soil, which differs from any of those above mentioned,—the shallow loam, on limestone basis, of the Forest of Dean. Hence it is evident that those qualities of soil, on which the strength and flavour of the liquor are supposed to depend, either are not discoverable from external appearances, or that liquors of nearly equal excellence may be obtained from soils essentially different.

My own experience induces me to accede to the latter opinion, and to believe, that with proper varieties of fruit, the defects of almost every soil and aspect might be corrected, and that fine ciders might be made in almost every part of England. Every variety of the apple is more or less affected by the nature of the soil it grows in; and the excellence of the ciders formerly made from the Redstreak and

Golden Pippin, and at present from the Stire, in light soils, seems to evince that some fruits receive benefit from those qualities in the soil, by which others are injured. On some soils the fruit attains a large size, and is very productive of juice; on others it is more dry and highly flavoured. Where the juice is abundant, but weak, which sometimes happens in the deep loam of the vallies, dry rich fruits, which are eminent for producing strong ciders, should alone be chosen: and when the aspect is unfavourable, or the situation cold and exposed, it seems sufficiently evident, that all fruits, which do not attain an early maturity, should be excluded. On some gravelly soils I have observed the fruit on the same tree to ripen very irregularly, and the cider to be (probably in part from this cause) harsh and rough: these defects would, I have no doubt, be removed by planting such fruits only as become ripe rather early in the season, and which are at the same time capable of being long kept, to attain a perfect and regular maturity, without decaying.

The most common defect in the orchards of Herefordshire, and the adjoining counties, is the want of a sufficient degree of warmth to bring their fruits to a perfect state of maturity; for almost all these, having acquired their fame in very warm and favourable situations, have been transferred from those to others, in which, except in very warm summers, they are never properly ripened. The liquor produced from them is consequently harsh and unpalatable, though it frequently possesses, from the nature of the fruit, a considerable degree of strength. The want of flavour and richness is always attributed to the soil, and I believe almost always unjustly; for I do not think Herefordshire so much indebted for its fame as a cider country to any peculiarity in its soil, as to the possession of a few very valuable varieties of fruit, for which it appears to be indebted to the industry of the planters of the last century. Those fruits will probably soon cease to exist; but as good, and perhaps better, may be again produced; for the skill of our forefathers was by no means equal to their industry. They were ignorant of the sexual system of plants, and appear to have been regardless in what situation, or soil, the seeds they sowed had been produced; expecting every thing from the richness of the mould in which those, and the plants produced from them, were afterwards placed. They also entertained great expectations from the use of aromatic infusions, in which they steeped the seeds, and with which the young plants were afterwards watered. They had probably observed that the milk and flesh of animals often retained the flavour of the herbs on which they fed, and therefore concluded that the juices of plants and fruits would be affected in a similar manner. But the latter, being unprovided with organs to reduce, or gastric juices to dissolve their food, receive their nourishment from vegetable and animal substances, only when these have been reduced nearly to their first principles by putrefaction, and when they have lost all specific character. Another erroneous opinion entertained by them was that any defect, either in the flavour or consistence of the fruits they had raised, might be remedied by the kind of stock on which they were afterwards grafted.

I have reason to believe, from considerable experience, that their labours generally began where they might as well have ended, and that no permanent change can be made in the future produce of the seeds by any mode of cultivation which can be adopted subsequent to their being taken from the parent tree. Each seed contains the root, the leaves, and germen of a future plant, and is converted into it by mere evolution; a rich or barren soil affording only a greater or less supply of nourishment to it, in its unfolded state. The growth of the young plants, and size of their fruit, will no doubt be greatest in rich soils; but if the trees, or grafts from them, be afterwards planted in a poor one, I believe the fruit in this will be, precisely what it would have been, had the trees originally grown in it. I have several times obtained two trees by grafting from a seedling plant of two years old, and planted the one in the garden, and the other in the cold clay of a very poor nursery. The appearance of the former has always been the most promising, but on taking grafts from each afterwards, I never could observe the least difference in the branches or leaves of the plants; nor has the fruit of several trees, which have borne, been any way altered.

The planters of the last century also believed that the produce of grafts would be permanently improved by inserting them on stocks of different species, and afterwards propagating from them; but I am confident that no improvement ever was, or will be, produced by this practice. They also attributed the disposition of their fruits to degenerate, when propagated from seed, rather to the action of the wild stock, than to the strong and natural propensity of the plant to return to it's original state. I believe this opinion to be entirely unfounded, but I cannot assert that it is so; and when new kinds are to be obtained from seeds, stocks raised from such cultivated fruits, as grow from cuttings, perhaps would be more eligible, though the goodness of the fruit is never affected by any stock of the same species.

When I first began to suspect that my endeavours to propagate the old fruits would not be successful, I selected the seeds of some of the best kinds with an intention to propagate new ones. But I soon found that many of the young plants (particularly those from the Golden Pippin) were nearly as much diseased as the trees which produced them. I several times raised three or four plants from seeds taken from one apple, and when this had been produced by a diseased tree, I have had not only as many distinct varieties as there were seeds, but some were much diseased, and others apparently healthy; though the seeds were sown in the same soil, and the plants afterwards grew within two feet of each other in the nursery. Grafts having been inserted from each, retained the habits of the tree from which they were taken. Few, however, if any of them appeared to possess a sufficient degree of vigour to promise me much success in their cultivation (except in very favourable situations) should their fruit be such as answered my wishes.

Having before observed that all the old fruits were free from disease when trained to a south wall, I thought it not improbable that seedling plants raised from them would be equally healthy; and that this would not be the sole advantage attending this mode of propagation; as the trees in this situation would enjoy all the benefits of a better climate, whilst their blossoms, being expanded before those of the neighbouring orchards, would escape all chance of being impregnated by the farina of inferior kinds.* With a view to try the effects of this experiment, I prepared stocks of the best kind of apple I knew, which could be propagated by cuttings, and after [illegible] planting them against a south wall in extremely rich mould, I grafted them with the Stire, Golden Pippin, and a few other fruits, whose time of ripening suited the situation in which I wished to plant. In the course of the ensuing winter the young trees were dug up, and (their roots having been retrenched) were again planted in the same places. This mode of treatment had the desired effect of making some of them produce blossoms at two years old. I suffered only one, or two, fruits to remain on each tree, which in consequence attained nearly three times their common size, with a very high degree of maturity and perfection; and the appearance of the plants I raised from their seeds, so much excelled any I had formerly obtained from the same fruits taken from the orchard, that, I think, I can confidently recommend the method I have adopted. I had chosen fruits possessing excellencies and defects of opposite kinds, with a wish to see, either through the industry of the Bees, or my own, the effects of a process similar to what is called by breeders of animals, crossing the breed. This consists in propagating from males and females not related to each other, and is certainly necessary, in those animals at least in which strength and spirit constitute excellencies, to prevent their degenerating. The experiment was easily made, and the singular effects I had seen produced by similar ones on other plants,* left me no reason to doubt that some effect would be produced in this. The good, and the ill effects, which follow the process of crossing the breeds of plants, are perfectly similar to those which have been observed amongst animals. If the male and female be taken from

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* The science of Botany is so widely extended, that it is scarcely necessary to inform any reader that there are males and females in the vegetable, as in the animal world. Each blossom of the apple and pear contains about twenty of the former, and five of the latter. I repeated the experiments of SPALLANZANI, on the Hemp plant, and on the Gourd, from which he has inferred that the sexual system does not extend to these plants. The result of my experiments does not by any means allow me to compliment the Italian Philosopher on his accuracy.

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* Blossoms of a small white garden Pea, in which the males had previously been destroyed, were impregnated with the farina of a large clay-coloured kind with purple blossom. The produce of the seeds thus obtained were of a dark gray colour, but these having no fixed habits, were soon changed by cultivation into a numerous variety of very large and extremely luxuriant white ones, which were not only

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only much larger and more productive than the original white one, but the number of seeds in each pod were increased from seven or eight, to eight or nine, and not unfrequently, in one variety, to ten. The newly made gray kinds I found were easily made white again by impregnating their blossoms with the farina of another white kind. In this experiment some of the seeds in the same pod would produce gray, and others white offspring, as occurs frequently in animals, which bring many young ones at a birth, when the breeds of the male and female are of different colours. Superfœtation also readily takes place in the Pea, when the farina of two plants is introduced into the same blossom. The reader may find a paper on this subject in the *Philosophical Transactions* of 1800. From some very imperfect experiments I have made, I am led to suspect that very considerable advantages would be found to arise from the use of new or regenerated varieties of wheat; and these are easily obtained, as this plant readily sports in varieties whenever different kinds are sown together.

from two permanent varieties of different characters, the immediate offspring will present a mixture of both characters, in nearly an equal proportion; but the progeny of this offspring will be extremely various. Some will take nearly the form of their male, and others of their female ancestry, and it will be long before a new permanent character is acquired. In perennial vegetables, the progress of variation and degeneracy may be arrested, when an individual answering our wishes has been obtained; as this individual, by the art of the planter and grafter, may be divided and multiplied to almost any extent. My experience induces me to believe that the effects of crossing tend strongly to stimulate the growth of the offspring both of plants and animals; but that amongst animals, crosses should be made only between breeds bearing a good deal of resemblance to each other, or between different families of the same breed.

From the open structure of the blossoms of vegetables, and from the numerous tribe of insects which feed on their honey or farina, a sexual intercourse must of necessity take place between neighbouring plants of the same species; and I am much more disposed to attribute this intercourse to the intention than to the negligence of nature. My wishes were, of course, to correct the defects, and to combine the different excellencies of the best fruits; and I was not without hopes that the offspring would possess a greater degree of strength and vigour, as it is known to do in cultivated animals.

A few days before the blossoms expanded of the kinds from which I wished to propagate, I opened the petals and destroyed the males in all the blossoms which I suffered to remain of one kind; taking great care to leave the females uninjured: and when these blossoms were fully expanded, I impregnated half of them with farina taken from another kind of fruit, leaving the other half to the care of the Bees; which were collected in great numbers, owing to the scarcity of flowers at that season, and passed busily from one blossom to another. I had soon the satisfaction to observe that every fruit, which I had impregnated, grew rapidly, whilst half of those on the other tree, which had remained in their natural state, failed; with every one of those left to the care of the Bees. Whence I was disposed to conclude that these insects were not so good carriers of the farina of plants as is, I believe, generally supposed by naturalists; but in subsequent experiments, where the blossoms on the neighbouring trees have been more numerous, I have had reason to draw a different conclusion.

The plants I have obtained from the fruits, on which this experiment has been made, are certainly much the most promising I have yet seen. Some of these seem to possess the character of the male parent, others that of the female; in some that of both appears blended, and in others, I do not distingush that of either. Whether any of them will remain free from hereditary disease and debility or not, remains to be proved. Every seed, though several be taken from the same apple, furnishes a new and distinct variety; and some of these will grow with more luxuriance than others, and the fruits produced by the different plants will possess different degrees of merit. An estimate may in some measure, be made of their good and bad qualities at the conclusion of the first summer, by the resemblance the leaves bear to the highly cultivated or wild kinds; as has been remarked by the writers, on this subject, of the last century.

The leaf, and general habit, of a seedling plant, will, however, by no means convey any correct idea of the merits of the future fruit. Where these have the character of high cultivation, the qualities of the fruit will be far removed from those of the native species; but the apple may be insipid or highly flavoured, green or deeply coloured, and of course well or ill calculated to answer the purposes of the planter. An early blossom in the spring, and an early change of colour in the autumnal leaf, would naturally be supposed to indicate a fruit of early maturity; but I have never been able to discover any criterion of this kind, on which the smallest dependance can be placed. The leaves of some varieties will become yellow and fall off leaving the fruit green and immature; and the leaves in other kinds will retain their verdure long after the fruit has perished.

The plants, whose buds in the annual wood are full and prominent, are usually more productive than those whose buds are small and shrunk into the bark; but their future produce will depend much on the power the blossoms possess of bearing cold, and this power varies in the different varieties, and can only be known from experience. Those which produce their leaves and blossoms rather early in the spring are generally to be preferred, for though they are more exposed to injury from frost, they less frequently suffer from the attacks of insects, the more common cause of failure.

The disposition to vegetate early, or late, in the spring, is like almost every other quality in the apple tree, transferred in different degrees, to its offspring; and the planter must therefore seek those qualities in the parent tree, which he wishes to find in the future seedling plants. The most effective method I have been able to discover of obtaining such fruits, as vegetate very early in the spring, has been by introducing the farina of the Siberian crab into the blossom of a rich and early apple; and by transferring in the same manner the farina of the apple to the blossom of the Siberian crab. The leaf and habit of many of the plants, that I have thus obtained, possess much of the character of the apple, whilst they vegetate as early in the spring as the crab of Siberia, and appear to possess an equal power of bearing cold. Of the merits of the fruit these will produce, I am yet unable to speak; but I have found that the mixture of equal weights of the fruit of the Siberian crab-tree, and of a rich apple, afforded a produce capable of making fine cider; and I have much reason to believe, from a great number of similar experiments on vegetables, that the liquor to be yielded by the produce of the sexual mixture of the same fruits will not be more harsh and unpalatable, than the mixture of the fruits themselves afforded. The Siberian crab, which has been introduced into the gardens of this country, affords a somewhat remarkable instance of the power, which plants possess, of adapting their habits to the climate in which accident, or the industry of man, has placed them. In the climate of Siberia, the change of seasons is extremely rapid, and summer almost instantly succeeds the solution of its snows. From the habits the crab has there acquired,* its seeds are very apt to mistake the termination of a frost in the end of January for the commencement of spring, and to expose themselves to almost certain destruction, by vegetating at that season. For this reason, they should always be planted in pots or boxes of mould ready to be removed into a place of shelter. The seeds of the English crab, which differs from the Siberian only in having adapted its habits to a different climate, trust themselves with more apparent caution to the changes of our unsteady seasons, and do not vegetate till the spring is a good deal more advanced. The crab of Siberia also, accustomed to the short, but warm, summers of that country, advances rapidly to maturity; whilst the long, though cool and shadowy summers of England, appear to have taught our native crab that there is no occasion for so much expedition. The offspring of each would probably retain their acquired habits during several generations, into whatever climate they might be introduced.

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* I am inclined to believe that by means of the artificial climate of a vinery, whose flues are heated only during the spring and summer, much more early varieties of the Grape, than any now known, might be obtained from seed. I have raised many plants, the mingled offspring of those kinds which now succeed best in the open air, to endeavour to ascertain this point. I do not however entertain an idea that vineyards will ever succeed in England, or that the grape will ever in such a climate afford a liquor equal in merit to the produce of the apple and pear.

The properties which constitute a good apple for cider, and for the desert, are seldom found in the same fruit, though they are not incompatible with each other. The firmness of the pulp, which is essential in the eating apple, is useless in the cider fruit, in the best kinds of which it is often tough, dry, and fibrous: and colour which is justly disregarded in the former is amongst the first good qualities of the latter. Some degree of astringency also, which is injurious to the eating fruit, is always advantageous to the other. Amongst the endless variety of kinds, which are found in Herefordshire, very few ever deserved the attention of the planter, and the greater part of those are only capable of attaining a proper state of maturity in very warm situations. When the rind and pulp are green, the cider will always be thin, weak, and colourless; and when these are deeply tinged with yellow, it will, however manufactured, or in whatever soil it may have grown, always possess colour with either strength or richness. The substances which constitute the strength and body in this liquor generally exist in the same proportion with the colour, though there does not appear to be any necessary connection between the tinging matter and the other component parts.

The apple being most easily propagated by grafting, the means of obtaining proper stocks must be amongst the first things to occupy the attention of the planter. A preference has generally, and justly, been given to those raised from the seeds of the native kind, or crab, as being more hardy and durable than those produced from the apple.

The offspring of some varieties of the crab, particularly of those introduced from Siberia, vegetate much earlier in the spring than other trees of the same species; and thence the inexperienced planter will probably

bably be led to suppose, that such stocks would accelerate the vegetation of other varieties in the spring, and tend to produce an early maturity of the fruit in autumn. In this, however, he will be disappointed. The office of the stock is, in every sense of the word, subservient;* and it acts only in obedience to the impulse it receives from the branches: the only qualities therefore, which are wanting to form a perfect stock, are vigour and hardiness.

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*"The stock giveth aliment, but no motion to the graft" LORD BACON. The keen and inquisitive mind of this extraordinary man appears to have penetrated deeply into the nature of vegetation; and in this, as in other branches of knowledge, to have anticipated the discoveries of succeeding generations. He has suggested the idea of improving fruits by combining the excellencies of different kinds, and conceives this to be practicable, tho' he says it cannot be done by grafting; because the graft wholly "over-ruleth" the stock. To LORD BACON also belongs the remark, that the lives of trees are greatly prolonged, when their branches are frequently taken off.

In collecting the seeds, to sow, it must be remembered, that the habits, as well as the diseases of plants are often hereditary, and attention should be paid to the state of the tree from which the seeds are taken: it should be large and of free growth, and rather in a growing state than one of maturity or decay. The crab-trees, which stand in cultivated grounds, generally grow more freely and attain a larger stature than those in the woods, and therefore appear to claim a preference.* The seeds should be taken from the fruit before it is ground for vinegar, and sown in beds of good mould an inch deep. From these the plants should be removed in the following autumn to the nursery, and planted in rows at three feet distance from each other, and eighteen inches between each plant. Being here properly protected from Cattle and Hares, they may remain 'till they become large enough to be planted out; the ground being regularly worked and kept free from weeds.

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* I believe that this remark may be extended to every species of forest tree, and that the offspring of a stunted oak, the hardy tenant of a welsh mountain, and of another tree of the same species, the more fortunate and gigantic inhabitant of the deep rich loam, and mild climate, of Herefordshire, would each retain a large portion of the acquired character of their parents, wherever planted.

A difference of opinion appears always to have prevailed respecting the quality of the soil proper for a nursery: some have preferred a very poor, and others a very rich soil; and both perhaps are almost equally wrong. The advocates for a poor soil appear to me to have been misled by transferring the feelings of animals to plants, and inferring that a change from want to abundance must be agreeable and beneficial to both. But plants in a very poor soil become stunted and unhealthy, and do not readily acquire habits of vigorous growth, when removed from it. In a soil which has been highly manured, the growth of young apple-trees is extremely rapid; and their appearance, during two or three years, generally indicates the utmost exuberance of health and vigour. These are however, usually the forerunners of disease, and the "canker's desolating tooth" blasts the hopes of the planter. I have seen many instances, in the black rich mould of an old garden, where young trees of the native crab could scarcely preserve their existence; and such mould appears almost equally fatal to the peach and nectarine trees. It has justly been remarked by Evelyn, that annual plants, having only a short time in which they are to fulfil the intentions of nature, readily accept any assistance from manure, and are rarely injured by the excess of it:

but that trees, being formed for periods of long duration, are injured when* attempts are made to accelerate their early growth by the stimulus of a large quantity of nutriment.

In chusing the situation for a nursery, too much shelter, or exposure, should be equally avoided; and a soil, nearly similar to that in which the trees are afterwards to grow, should be selected, where it can be obtained. Pasture ground, or unmanured meadow, should be preferred to old tillage, and a loam of moderate strength, and of considerable depth, to all other soils.

At whatever season grafts are intended to be inserted, the branches, which are to

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* I have some good reasons to believe that an excess of highly nutritive and stimulating food is highly injurious to young animals, as well as to young trees, tho' it seems the fashion of the hour amongst medical men to think otherwise.

form them, should be taken from the parent stock during the winter, and not later than the end of the preceding year: for if the buds have begun to vegetate, in the smallest degree, and they begin with the increasing influence of the sun, the vigour of the shoots, during the first season, will be diminished; and the grafts will not succeed with equal certainty; though a graft of the apple-tree very rarely fails, unless by accidental injury, or great want of skill in the operator. The amputated branches must be kept alive, 'till wanted, by having the end of each planted in the ground, a few inches deep, in a shady situation.

The propriety of grafting near the ground, or at the height of six or seven feet, will depend on the kind of fruit to be propagated, whether it be quite new and just beginning to bear, or a middle-aged variety. In new and luxuriant varieties, and these only should be propagated, it will be advantageous to graft when the stocks are three years old, as the growth of such will be more rapid, smooth and straight, than that of the crab, and there will be no danger of these being injured by beginning to bear too early: not, however, because they will bear less abundantly than others; but because they will support a heavy crop of fruit, and grow very considerably in the same season. I, nevertheless, formerly conceived it probable that grafts from middle aged varieties, having attained a more perfect state of maturity, would be most productive of fruit. The close analogy between vegetable and animal beings might, however, have induced me to infer, what subsequent experience has taught me, that the power and disposition in plants, as in animals, to produce the most numerous offspring, is greatest during their youth. It may nevertheless be questioned whether the fruit of a newly raised variety of the apple will possess all the merits of the same fruit at its maturer age; and this is a question of no easy solution. The man, who shall have marked the gradual change, during a sufficient number of years, will find himself no longer young; and an old man, the "Laudator temporis acti," though his organs should remain unimpaired, will not readily admit that the fruit, which he remembers as a boy, has improved. In the decay of each variety, its merits appear to decline; for I feel too much deference for the opinions of our ancestors not to believe that the Redstreak and Golden Pippin were once better cider apples than they are at present; and it also appears extremely probable that the fruit should be affected by the diseased and debilitated state of the tree. Middle-aged kinds will be most successfully propagated by planting stocks of six or seven feet high, and letting them remain ungrafted 'till they become firmly rooted in the places in which the trees are to stand. One graft only should be inserted in each stock; for when more are used, they are apt to divide when loaded with fruit, and to cleave the stock, having no natural bond or connection with each other. When the stocks are too large for a single scion, I would recommend that the grafts be inserted in the branches, and not in the principal stem.

Could the future produce of young seedling trees be ascertained with accuracy, at four or five years old, much advantage would arise from inserting buds in the annual shoots of stocks of the same age, at the height of six or seven feet; as the planter might then be in possession of a number of trees of any variety, just at the age when it arrived at the bearing state; and would be able to command a large number of grafts, as early as the merits of the fruit were known. No means by which the effects of time on the apple tree can be anticipated have yet occurred to me; but I do not despair of future success. In the common manner of growth in trees, the lateral buds are formed in one season, and expand into shoots in the next. But if the point of a seedling tree, when it is a few weeks old, be pinched off, one (or more) of the uppermost lateral buds almost immediately vegetates; and if the point of the shoot, this affords, be in the same manner taken off, the lateral buds again vegetate like the preceding; and the same process, with the aid of artificial heat may be repeated seven or eight times in the first year. When two lateral buds have shewn a disposition to vegetate with nearly equal vigour, I have in the present year, in several instances, taken off the shoot immediate above the second bud, and then inserted the amputated part, as a graft, within the bark of the annual shoot of a stock of four years old. Several grafts, thus inserted in june and july, have succeeded perfectly well, and the leaf and general character of the shoots, these have produced, appear sufficiently different from those of annual plants, to encourage very sanguine hopes of success. I am not, however, quite satisfied that the annual plant will not be permanently injured by having its vegetation so frequently checked; and therefore I shall in future try my experiments on grafts taken from seedling plants during their first winter: one year only can be lost, and the seedling tree by this delay is sure to escape free from injury.

Though the quality of the fruit of a seedling tree cannot be ascertained whilst very young, I always insert a few grafts from every tree, whose appearance is very promising; because by having several trees of the variety I can better ascertain it's vigour and hardiness, and at the same time am enabled to gain a more correct idea of the form and character the variety will take in it's future growth, than can ever be obtained from a single plant. The trees thus grafted, will also attain nearly the same height and size as those which have been left in their natural state, and (should their fruit not be found valuable) will be just as proper as those to be grafted in the manner recommended with aged varieties. Care must, however, be taken to use the scions of such trees only, as are perfectly healthy and vigorous. An opinion was formerly entertained, and does not at present appear to be quite obsolete, that fruits might be improved by this process of double-grafting; from the changes the sap was supposed to undergo in it's passage through a stem belonging to different kinds of fruit. But I am inclined to think that no such changes take place, and that the leaf is the chief laboratory in which nature prepares the juices of plants, and in which these acquire the power to generate and deposit the new matter that constitutes the annual increase of the tree. The width, and thickness of the leaf, generally indicate the size of the future apple, and the colour of the black cherry, and purple grape, may be known by it's autumnal tints, even in plants which have sprung from seed in the preceding spring. The tinging matter, in the leaves of these, is probably of the same kind as that, to which the fruits will in future owe their colours. I have had some reason to believe that each variety of fruit requires it's own peculiar leaf; for I have several times grafted the branches of young apple and pear-trees close above some buds containing blossoms; and these, in four instances, produced fruit, which grew well, as long as I left any of their own leaves on the tree: but when I took those away, and none remained but those of the grafts, which were of other kinds, they withered and fell off. Whether their falling was occasioned by the want of proper nourishment, or by some other cause, is a question on which I am not prepared to decide. I am, however, disposed to attribute their falling to some other cause; for the vessels which carry nutriment to the fruit, do not appear to me to have any intimate connection with those of the adjoining leaves, and I have some reason to believe that a fluid, of the same kind, is conveyed, by similar vessels, into the fruit and leaf.

The inexperienced planter will suppose that much time will be lost in propagating new kinds, as these will not produce fruit so soon as grafts of those which have been long in cultivation: but he will soon find that the fruit of very small young trees by no means repays him for the injury they sustain in growth. If the seeds, from which new varieties were expected, and those intended merely to produce stocks, were sowed in the same season, the merits of those varieties would generally be known, as early as the stocks would have gained proper size and strength in the nursery, and have become, after being moved, firmly rooted in the ground, where they are to remain: and if the stocks were then to be grafted in the branches, with those new varieties, I know no means by which an orchard could be better, or more expeditiously raised.

It has been recommended to remove the young trees once or twice during the time they remain in the nursery, under the idea of increasing the number of their roots; but I think this practice only eligible with trees which do not readily grow when transplanted. I have always found the growth of young apple-trees to be much retarded, and a premature disposition to blossom to be brought on by it, and I could not afterwards observe that those trees, which had been twice removed, grew better than others. It has also been supposed that many small roots, proceeding immediately from the trunk, are in the future growth of the tree to be preferred to a few large ones; but as the large roots of necessity branch into smaller ones, and probably extend to a greater distance, the advantages of more transplantations than from the seed-bed to the nursery, and thence to the orchard, may reasonably be questioned.

The apple-tree succeeds best in situations which are neither high, nor remarkably low. In the former it's blossoms are frequently injured by cold winds, and in the latter by spring-frosts, particularly when the trees are planted in the lowest part of a confined valley. A south, or south-east, aspect is generally preferred, on account of the turbulence of the west, and the coldness of north winds: but orchards succeed well in all aspects; and where the violence of the west-wind is broken by an intervening rise of ground, a south-west aspect will be found equal to any. The trees attain their largest stature in a deep strong loam; but will grow well in all rich soils, which are neither excessively sandy, nor wet. An orchard generally is most productive of fruit, when it is situated near the fold-yard, and is in consequence much trodden and manured by the Cattle in the winter; and hence it will not unfrequently be found advantageous to plant on the site of an old orchard. The ground, however, in which old apple-trees have grown, is esteemed very unfavourable to young ones. When from contiguity to the house, an orchard is planted in this kind of ground, the pear and apple should be made to succeed each other, as has been judiciously recommended by Mr. Marshall.* The roots of the pear-tree descend to a greater depth in the ground than those of the apple-tree; and as the stocks, of neither of these fruits, will afford proper nutriment to the other, it may be questioned whether their action on the soil be perfectly similar.

In the choice of fruits for every situation, attention should be paid to select such as are sufficiently early to ripen well in it; for if the fruit be not ripe, it's produce must ever be crude, harsh, and unpalatable. A cider-apple may be safely pronounced to be too late for the situation it occupies, when it does not become yellow before the end of October; and I do not know any disadvantages attending a more early maturity; provided the kinds of fruit be capable of being kept a few weeks. An opinion, I have observed, prevails that the liquors obtained from all early fruits are without strength, or body; but the strongest cider, yet known, is produced by one of these, the Stire; and I have met with two other varieties, evidently capable of making extremely strong ciders, which ripen in the end of August.

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* Rural Economy of Gloucestershire.

In cold and unfavourable situations, those fruits will best repay the planter, which in their general character appear nearly related to the native kind, or crab; for though the flavour of these be austere and ungrateful to the palate, the ciders produced from some of them, when they have been thoroughly ripened, are often found smooth and generous. I would recommend the grafts to be taken from an improved crab, in preference to a degenerated apple; for the former will possess much of the hardiness and vigour, whilst the latter will often inherit the debility and diseases, of the parent-tree. Proper fruits of this kind might probably be obtained from a crab of a deep yellow colour, and in taste rather astringent than acid, trained to a south-wall, and impregnated with the farina of a rich early apple, in the manner already recommended. Both the red, and the yellow, Siberian crabs possess qualities, which appear to give them great advantages over every English variety: their blossoms are, in an extraordinary degree, capable of bearing cold; the fruit attains a very perfect and early maturity; it is in colour and beauty unrivalled, and contains but a moderate portion of acid, compared with its astringency.

I am well satisfied that the fruits, I have obtained from these, will flourish and make fine ciders in many situations where kinds which have been more improved by cultivation will not succeed, and when old trees, whose branches have been taken off, are to be regrafted, I have no doubt but that fruits of this kind, just arrived at the bearing age, may be used with very great advantage. The leaf and habit of an improved crab will generally indicate a worse fruit, and of a degenerated apple a better, than the trees will afterwards produce; but this remark does not appear to me to be applicable to those fruits, whose degeneracy, or variation, has been produced by the introduction of the farina of another kind.

The fruit trees of Herefordshire are generally planted in quincunx, or in straight lines crossing each other at right angles. The former method is preferred in the hop-yards and pasture, and the latter, being less inconvenient to the ploughman, in tillage. But it appears to me that any given number of trees planted near each other in rows, with wider intervals between those rows, would be less injurious, either to pasture and tillage, than in either of the preceding methods. The trees in each row should in this case be of the same variety of fruit, that no one, by possessing greater vigour and luxuriance, might overgrow and shade another, and that the whole row might appear a continuation of the same tree. The intervals between would afford considerable space for the plough or pasture, and every tree, having room to extend it's branches on each side, would be more protected than injured by its neighbours, and would attain nearly, or quite, as large a stature as if entirely insulated. The cider-maker would also be enabled to collect with convenience each kind by itself, and might afterwards mix them according to his judgment, or caprice. Unless an orchard be very large, not more than five, or six, kinds should be planted in it, and if some of these be such as blossom early, and others late, the planter will have as good a chance of an annual supply of fruit, as a larger number of kinds would afford him.

The distance between each row, as well as the space between each tree, must depend on the situation and soil. When the former is high and exposed, the trees should be closely planted to afford each other protection; and when the latter is poor and shallow their growth will of course be diminished, and they will consequently require less room. But in low and sheltered situations, and deep rich soils, where the trees are little exposed to winds, and attain a large size, wider intervals must be allowed them. In the former instances, a distance of twelve yards between each row, and half as much between each tree, will be sufficient; in the latter twenty-four yards between each row, and eight between each tree, will not be found too much; particularly if the ground be intended for tillage after the trees have grown to a considerable size. An opinion rather generally prevails at present in favour of planting single trees at twenty or twenty-five yards distance from each other on arable grounds, and specious reasons may be offered in defence of this practice. The roots, as well as the branches, are at perfect liberty to extend themselves in every direction; but the latter are every way exposed to the storms of autumn, and to the cold winds of the spring; and trees, of more hardy kinds than the apple, are well known to grow much better when planted near enough to afford each other protection, than when totally insulated. It may be supposed that trees growing in distant rows will not regularly occupy the whole surface of the ground with their roots, but these always extend far beyond the branches, and will meet across very wide intervals.

Closely planted orchards, where the trees afford each other protection, will ever be found most productive in a climate which is as subject as ours to great and sudden changes of temperature; but nevertheless, there are situations in which single trees, particularly such whose growth is tall and aspiring, will best pay the planter and the community. When the branches of a single tree are raised moderately high from the ground by the length of the stem, the whole of the herbage beneath it receives, during some part of the day, the full influance of the sun; and it is in consequence as readily eaten by stock of every kind, as the produce of any other part of the field. I have seen some instances in which five or six trees, regularly dispersed over an acre of pasture, have been highly beneficial; and I have never seen any instance in which such a number has been any way injurious. Six of such trees, where the ground is good, and the variety properly chosen, will annually afford a produce of more than a hundred gallons of cider, which will generally be found to exceed in value the rent of the ground which produced it.

Where the mode of cultivation will admit, the rows should always extend from north to south, as in this direction each part of every tree will receive the most equal portions of light and heat.

An orchard is generally raised with most success, and at least expence, in a hop-yard; the ground under this culture being always well tilled and manured, as well as fenced against all kinds of cattle. Considerable advantages may be obtained by planting twice the number, which are to remain, of trees in each row, using two kinds of fruit, and putting each alternately. The kind which succeeds best may be left, and the other be removed and planted on tillage or pasture, or employed in filling up vacancies in orchards. Trees of a large size may be transplanted without the least danger in the autumn, particularly if the roots be shortened in the preceding winter. The subsoil of the ground which suits the hop is not unfrequently too moist for the apple, and this defect is rarely removed by draining. Where a hop-yard is wanting, trees may be raised in tillage or pasture; but the expence of defending them properly will be considerable, particularly in the latter, in which though ever so well defended they usually make but a slow progress. In tillage the least expensive, and perhaps the best method of raising an orchard will be to exclude for a few years, every species of cattle, except sheep and pigs, and to defend the trees only with small branches bound round their stems, as in the broom or besom of the farm-house. This fence must begin close to the ground and rise to a greater height than the sheep or pigs, or the chains of the horses in ploughing can reach; and to preserve the bottoms of the stems from injury by the plough, a strong oak stake should be driven into the ground on each side of every tree. The small branches which defend the stems will require to be replaced every other year; but this will be done at a very trifling expence.

When a plantation is to be made in pasture ground, timber-frames will be found necessary. The kind most in use at present is made with two flat posts placed with their wide surfaces parallel to each other at two feet apart, having boards nailed to their edges on each side with small distances between them. The trees are here perfectly protected from cattle; but when their branches extend themselves, and become agitated by the wind, the stems can scarcely escape being rubbed against the frames. Another, and I think, a much better kind of frame, is made with three posts placed triangularly round the tree, approaching each other at the roots and diverging considerably upwards. This appears more expensive than the other; but timber of much inferior value may be used. In this method of planting the formality of the row may be dispensed with, but the trees will succeed much better if three or five be planted near each other with wide intervals, than if each stand entirely alone.

The custom of planting in hedge-rows has fallen into disuse: it has however still it's advocates. The Trees are here raised with little or no expence, and if planted at twenty-five or thirty yards apart, and raised on high stems, they do little injury to the hedges, or fields which are not tilled: and if the fence should be injured, when the trees have attained a large size, the value of their fruit in a single year will be often more than adequate to the expence of planting a new one, which may be removed:

ved to just such a distance as to avoid their shade. I am an advocate for the practice; but I think the pear-tree ought almost always to be preferred to the apple-tree.

Little care is required, though *more* than is generally given in Herefordshire, in transplanting the crab-stocks or apple-trees; but in removing from the nursery to the orchard attention should be paid to leave the roots as long and as little injured as possible, and not on any account to bury them deeper than they formerly grew. The soil round each tree should be dug eighteen inches deep, and four or five feet wide, placing the sod, if the ground be paſture, in the bottom of the holes, as recommended by Mr. Marshall. If the holes, in this case, be made six months before the time of planting, and if a small quantity of rich mould be mixed with that of the field immediately round the roots, it will much accelerate the future growth of the trees.

The varieties of fruit best calculated for pasture grounds are of small size; for such are generally much less liable to be blown prematurely from the tree; and if blown down, there will be no danger of the Cattle being choaked by eating them. Indeed I am not acquainted with any advantage the Planter, in any situation, derives from large apples. Individually they evidently yield a larger quantity of liquor; but it is almost always of inferior quality, and whatever be the size of the fruit, each tree can ſupport only a certain weight. The Siberian crab possesses many excellent qualities as fruit for pasture, and probably may transfer some of these to its offspring.

The branches of the trees, when removed, whether grafted or not, and wherever planted, should be much retrenched, and the mould may be raised a few *inches* round the stems to prevent their being shaken by the wind. A stake to each will also be of much service, if care be taken to prevent the bark of the tree receiving injury by being rubbed by it.

Wherever a plantation is to be made, the autumn is the most eligible season; but if from any cause the planting be delayed 'till spring, the trees will succeed perfectly well, if the soil, or succeeding season, be not remarkably dry. When the trees have once taken root in the hop-yard or tillage, they will not require any thing more than protection from the planter; but in the pasture the ground should be annually dug three or four feet wide round each, during the first four or five years.

There are few plantations, now existing, in which many middle-aged trees, of diseased and unproductive varieties, are not to be found. These should be immediately regrafted; but unless this operation be performed with more judgment, than usually belongs to the common grafter, it will often be fatal to the tree. The grafts will, however, almost always succeed during the first three or four years, and then perish, together with the stock. It not unfrequently happens that the scions inserted belong to as old, and as diseased, a variety as that which has been taken off; and in this case the graft, and the stock, appear to die by mutual consent. When old trees are to be regrafted, the scions of a very young and hardy variety, of extremely vigorous growth, should be selected; and the grafts should be inserted in the large branches at some distance from the trunk; and never, where it can be avoided, in the principal stem itself. Large scions should be used; for these take a deeper and firmer hold of the stock than small ones. The thick covering of lifeless external bark should, at the same time, or in the succeeding winter, be totally pared off, care being taken that the internal bark be not any where cut through. The effects of this operation will be found extremely beneficial to the tree, in its future growth; and it will not be difficult to trace these effects to their cause. From very numerous experiments on the ascent and progress of the sap in trees, made by means of coloured infusions, and by taking up the vessels in different parts, I am perfectly satisfied that the ascending and descending fluids are carried to every part of the tree, through the following channels.—Having been absorbed, from the adjacent mould, by the bark of the root, the sap ascends wholly through the alburnum, or sap-wood, of the root and trunk; and it is by this substance, independent of the bark, carried in the spring, to those buds which produce the annual shoots of the succeeding summer. In the buds and annual shoots, the sap is received by another species of vessel, and is impelled forward by a new agent, into the leaves. In the leaves it is exposed to the air and light, and some portion of the water, it contains, appears to be decomposed: new combinations here probably take place, into which the matter of light, and of heat, if the latter be material, may possibly enter. From the leaf, the sap is returned, through another set of vessels, into the inner bark, and in its passage downwards deposits the new matter, which annually forms the increase and extension of the branches, the trunk, and the root. The fruit derives its nourishment through a set of vessels similar to those which supply the leaves; and the apple appears to have an internal circulation a good deal similar to that of the leaf; but of a more complex kind.* In an old tree, which has a thick covering of rigid and unexpansible bark, the descent of the sap must be greatly impeded in its passage: but nature is ever full of resources, and expedients; and the motion given to the trunk and branches by the winds, evidently tends, like the spontaneous motion of the limbs of animals, to accelerate that circulation, which it does not create. This motion is wholly lost by the grafted tree, when it has been deprived of its branches;

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* The ROYAL SOCIETY have done me the honour to order an account of the experiments, from which the foregoing conclusions are drawn, to be printed in the Philosophical Transactions of the present year.

ches; the sap in consequence stagnates under the rigid cincture of the external bark; and the death of the tree is the natural consequence. The growth in the trunks of some very old trees, which were grafted five years ago, and deprived of their external bark in the last winter, has been perfectly astonishing, in the present season, and appears to me to have exceeded greatly that of the five preceding years, in the aggregate.

The apple-tree, being naturally very full of branches, frequently requires the operation of pruning; and when properly executed, great advantages will be found to arise from it. But as it is generally performed in Herefordshire, the injury the tree sustains is much greater than the benefit it receives. The ignorant pruner gets into the middle of it, and lays about him to right and left, 'till he leaves only small tufts of branches at the extremities of the large boughs. These branches, now receiving the whole nourishment of the tree, of course increase rapidly, and soon become, when loaded with fruit or snow, too heavy for the long naked boughs, which are of necessity full of dead knots from the former labours of the pruner, to support. Many hundred trees annually perish from this cause. The present system of pruning ought to be precisely reversed; and the pruner should confine himself almost entirely to the extremities of the bearing branches, which are always too full of wood, and leave the internal part of the tree, nearly as he finds it.

In pruning the apple-tree, and all other standard trees, the points of the external branches should be every where rendered thin, and pervious to the light; so that the internal parts of the tree may not be wholly shaded by the external parts: the light should penetrate deeply into the tree, on every side; but not any where through it. When the Pruner has judiciously executed his work, every part of the tree, internal, as well as external, will be productive of fruit; and the internal part, in unfavourable seasons, as I shall have occasion to remark when speaking of Blights, will rather receive protection, than injury, from the external ones. A tree, thus pruned, will not only produce much more fruit, but will also be able to support a much heavier load of it, without danger of being broken: for any given weight will depress the branch, not simply in proportion to its quantity, but in the compound proportion of its quantity, and of its horizontal distance from the point of suspension; by a mode of action similar to that of the weight on the beam of the steelyard: and hence a hundred and fifty pounds, suspended at one foot distance from the trunk, will distress the branch, which supports it, no more than ten pounds at fifteen feet distance would do. Every tree will therefore support a larger weight of fruit, without danger of being broken, in proportion as the parts of such weight are made to approach nearer to its centre.

Each variety of the apple has its own peculiar form of growth; and this it will ultimately assume, in a considerable degree, in defiance of the art of the pruner. Something may nevertheless be done to correct whatever is defective. When the growth of any variety is weak and reclining, the principal stem should be trained to a considerable

siderable height, before it be allowed to produce branches; and if any of these take an horizontal, or pendent direction, they should be regularly taken off. One principal leading stem should be encouraged almost to the summit of the tree, to prevent a sudden division into two large boughs, of nearly equal strength; for the fork which these form, is apt to divide and break, when the branches are loaded with fruit. All efforts to give the heads of young trees a round and regularly spreading form, whilst in the nursery, will be found injurious in the future stages of their growth. Large branches should rarely, or never be amputated.

In the garden-culture of the apple, where the trees are retained as dwarfs or espaliers, the more vigorously growing kinds are often rendered unproductive by the excessive, though necessary, use of the pruning-knife. I have always succeeded in making trees of this kind fruitful by digging them up, and replacing them, with some fresh mould, in the same situation. The too great luxuriance of growth is checked, and a disposition to bear is in consequence brought on.

Through the negligence of the Herefordshire farmers their orchards are often greatly injured by misletoe and moss. The first of these plants is easily removed, and as it makes excellent food for ewes in the spring, it is almost always worth the expence of collecting at that season. Moss* appears to constitute a symptomatic, rather than a primary, disease in fruit trees: it is often brought on by a damp, or uncultivated

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* The parasitical plants, which constitute this disease, are rather Lichens, than Mosses. None of the species of the latter genus are in any considerable degree injurious to fruit trees.

cultivated soil, by the age of the variety of fruit, and by the want of air and light in closely planted unpruned orchards. In these cases it can only be destroyed by removing the cause to which it owes it's existence.

Blights are produced by a variety of causes, by insects, by parasitical plants, by an excess of heat or cold, of drought or moisture; for these necessarily derange and destroy the delicate organization of the blossom: but I believe the common opinion, that they arise from some latent noxious quality in the air, or from lightning, to be totally unfounded. The excessive heat, which usually precedes lightning, is highly injurious to the blossoms of fruit trees; but I believe the lightning itself to be perfectly inoffensive. The term "Blight" is very frequently used by the gardener and farmer without any defined idea being annexed to it. If the leaves of their trees be eaten by the caterpillar, or contracted by the aphis; if the blossoms fall from the ravages of insects, or without any apparent cause, the trees are equally blighted: and if an east wind happen to have blown, the insects, (or at least their eggs) whatever be their size, are supposed to have been brought by it. This opinion, which was absurdly entertained by the philosophers of the last age, probably has owed it's existence to the hazy appearance of the air, which usually accompanies warm days and frosty nights, with a north east wind, in the spring.

The leaves and blossoms of the apple-tree are sometimes almost entirely destroyed by numerous tribes of caterpillars. These are the offspring of different species of moths; some of which deposit their eggs in the spring, and others during the preceding autumn, on those trees where the caterpillars afterwards commit their depredations. The caterpillar, however, not unfrequently falls from one tree, and ascends the trunk of another; and it is sometimes, whilst suspended by it's web, carried by the wind from one tree into the branches of a contiguous one; but this insect never, like the more sagacious spider, gives it's web to the winds, to afford itself the means of passing from one elevated point to another.* The eggs, from which the caterpillars spring, are much too minute and numerous to be destroyed by human industry; and therefore, in the destruction of these insects, it must be left to nature to retrench it's own exuberance.

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* I have frequently placed a spider on a small upright stick, whose base was surrounded by water, to observe its most singular and curious mode of escape. After having ascertained that the ordinary means of retreat are cut off, it ascends to the point of the stick, and standing nearly on its head, ejects it's web, which the wind readily carries to some contiguous object, Along this the sagacious insect immediately

Another insect, whose attacks on the apple-tree are often almost entirely destructive of it's fruit, is a small brown beetle. This insect, when very minute, and long before it assumes it's winged state, or form, penetrates the blossom by perforat-

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immediately effects it's escape, not, however, 'till it has previously ascertained, by several exertions of it's whole strength, that it's web is properly attached at the opposite end. I do not know that this instance of the sagacity of the spider has been noticed by any entomological writer; and I insert it here in consequence of having seen, in some periodical publication of the present year, a very erroneous account of the origin of the spider's threads, which are observed to pass from one tree or bush to another, in dewy mornings.

ing one of the petals, and having gained possession of it's internal part, prevents its further expansion by means of its web, and destroys those parts of it, on which the existence of the future fruit, in a great measure, depends. In the end of June, or the beginning of July, this insect quits it's habitation, in it's winged state; and it then lays those eggs on the trees, which afford a succession of insects for the succeeding season. On what part of the trees these insects deposit their eggs, I am ignorant; but it is probably near those buds, which contain the future blossoms. The depredations of this insect are usually fatal to a large portion of the blossom, when the time of it's expansion has been preceded by hot and dry weather.

The numerous and prolific family of the aphis is sometimes injurious to the apple-tree, whilst in the nursery; but rarely to any great extent; and in the orchard, it's attacks are too minute to attract, or to deserve, the attention of the planter. To the cultivator of hops, the aphis is a more formidable enemy. The honey-dew is unquestionably produced by this insect, in the manner described by the abbé Boissier de Sauvages. This writer has, however, considered the honey-dew to be of two kinds, one of which is ejected by the aphis, and the other a morbid exsudation from the plant; but in this I think he is mistaken. It must nevertheless be admitted, that the leaves are often covered with honey, on plants where a single aphis cannot be found; and that the aphis, in other instances, is seen without the honey-dew. But honey is not a volatile substance, and will thence remain, when it has become dry on the leaves, 'till it is washed off by rain; and when it has been moistened by dew, it will assume the appearance of a recent exsudation: and the aphis will frequently be found without the honey-dew, because it certainly does not produce any in every stage of it's existence. I have very frequently placed plates of talc, and of glass, under the leaves of fruit trees where different species of the aphis abounded; and I have always found these substances, in a few hours, to be covered with honey-dew: and I have at other times, by the following means, distinctly seen the honey fall from the under sides of the leaves, where the insects adhered. Placing a small branch, containing a numerous colony of insects, in the window of my study, where the sun shone strongly upon it, I closed the shutters, so as to exclude all light, but that which fell directly upon the branch. In this situation the drops of honey became extremely visible by the refraction of light, and appeared evidently to be impelled from the insect with very considerable force. Each drop contained a number of minute white points, which I suspected to be the eggs of the aphis; but as I knew the singular modes of generation in this insect had much engaged the attention of naturalists, I did not examine with the attention necessary to decide that point.

The species of parasitical plants which are found, in the form of disease, on other plants, appear to me to exceed the number of those I have any where seen described by botanical writers. Of these the mildew is the most obvious, and the most destructive. If a branch infected with this disease be struck with the hand, in calm dry weather, a quantity of white powder will be seen to fly from it; and if this powder be received on a plate of talc or glass, and be subjected to the microscope, it will be found to consist of extremely numerous oval bodies, evidently organized: these are unquestionably the seeds of the mildew. There is another plant, differing from this only in colour, being brown, which is frequently found on young apple-trees whilst in the nursery. Both these plants appear evidently to be species of mucor;* and like other species of that genus they abound most in low and damp situations; but do not exclusively belong to such.

Whatever may be the agent,† by which motion is given to the fluids within the vessels

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* The red and white mould on hops, and the black spots observable on the stalks of corn, appear to belong to this genus. The last species has been noticed by VIRGIL————mala rubigo
Esset culmos.

† For my opinions on this subject, I must refer the reader to the paper already cited in page 88.

vessels of plants, we have abundant evidence to prove that the progress of the ascending sap is accelerated by heat; and that it is checked, and totally suspended, by certain degrees of cold; and hence in a climate so subject to sudden variations of temperature, as that of every part of Britain is, during the spring, the progress of vegetation must be extremely irregular and uncertain. It frequently happens that a very cold night is succeeded by a very hot day: by the former the progress of the sap is suspended, whilst by the latter the evaporation from the expanded buds is greatly increased. The blossom in consequence fades from want of nutriment, where it's essential parts have escaped immediate injury from the frost: the farina withers and dries on the antheræ, and fecundation fails to take place.* The same ill effects are produced by cold drying winds. In each of these cases I have always seen those trees most productive of fruit, which, having had the good fortune to escape the desolating hand of the pruner, were moderately full of wood, and capable of affording their blossoms some protection from frost and cold winds, or excessive heat. I would not be understood to disapprove of judicious pruning; on the contrary I think it ought very frequently to be done; but the tree ought always to retain, internally at least, much of

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* The apple being merely the capsule or seed-vessel, will sometimes attain maturity without being

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impregnated; but this, like the fruit of other plants, will be without seeds. I have often attentively destroyed the male blossoms of the cucumber, and the antheræ of the pea; when the fruit of the one, and the pod of the other, generally attained their usual size; but the seeds remained nearly as they were before the blossoms expanded. In the gourd, the seed-coats attained their proper size and external character; but did not contain any vestige of lobes or plantule within them.

of the close branchy growth, which it's nature always gives it. The pruning-knife may, however, be used with some degree of freedom on young trees, for the branches of these soon repair any breaches which may be made in them; but if an old tree, or one which has ceased to grow larger, be so thinned as to admit a free current of air through it, it is ruined for ever. It has been supposed that the fruit, which stands exposed to the sun and air on the outsides of the branches, is alone capable of making fine cider; but experience by no means justifies this conclusion. When a tree has been pruned according to the preceding directions, the fruit, on every part of it, will be found to possess very nearly the same degree of excellence.

A part of the Herefordshire Farmers are extremely well skilled in the management of the fruit, and in the subsequent manufacture of their cider; but the greater number are almost entirely ignorant of both. To the latter class only the following observations, in which I shall do little more than detail a part of the practice of the former, are addressed.

The merit of cider will always depend much on the proper mixture, or rather on the proper separation, of the fruits. Those whose rind and pulp are tinged with green, or red, without a mixture of yellow, (for that colour will disappear in the first stages of fermentation) should be carefully kept apart from such as are yellow, or yellow intermixed with red. The latter kinds, which should remain on the trees 'till ripe enough to fall without being much shaken, are alone capable of making fine cider. Each kind should be collected separately, and kept 'till it becomes perfectly mellow. For this purpose, in the common practice of the country, it is placed in heaps of ten inches or a foot thick, and exposed to the sun and air, and rain; not being ever covered except in very severe frosts. The strength and flavour of the future liquor are, however, increased by keeping the fruit under cover some time before it is ground; but unless a situation can be afforded it, in which it is exposed to a free current of air, and where it can be spread very thin, it is apt to contract an unpleasant smell; which will much affect the cider produced from it. Few farms are provided with proper buildings for this purpose on a large scale; and the improvement of the liquor will not nearly pay the expence of erecting them. It may reasonably be supposed that much water is absorbed by the fruit in a rainy season; but the quantity of juice yielded by any given quantity of fruit will be found to diminish, as the fruit becomes more mellow, even in very wet weather; provided it be ground when thoroughly dry: and I am not quite satisfied that the apple does not receive benefit from the sun and light, subsequently to it's being taken from the tree. The advantages therefore of covering the fruit will probably be much less, than may at first sight be expected.

No criterion appears to be known, by which the most proper point of maturity in the fruit can be ascertained with accuracy; but I have good reason to believe that it improves, as long as it continues to acquire a deeper shade of yellow, without decaying. Each heap should be examined prior to it's being ground, and any decayed or green fruit carefully taken away. The expence of this will be very small, and will be amply repaid by the excellence of the liquor, and the ease with which too great a degree of fermentation will be prevented. Each kind of fruit should either be ground separately, or mixed with such only as becomes ripe precisely at the same time; but it is from the former practice that fine ciders, of different flavours and degrees of strength, are best obtained from the same orchard. The practice of mixing different varieties of fruit will, however, often be found eligible; for it is much more easy to find the requisite quantities of richness, astringency, and flavour, in three varieties of fruit, than in one; and hence ciders, composed of the juice of mixed fruits, are generally found to succeed with greater certainty, than those made with any one kind. By mixtures, also, the cider-maker, being able to give to each cask a greater or less portion of acid or astringency, may best accommodate different portions of his liquor to different palates and constitutions.

In grinding, the fruit should be reduced, as nearly as possible, to an uniform mass, in which the rind and kernels are scarcely discoverable. The advantages, which ciders receive from the perfect execution of this process, are well known to the Herefordshire Farmer; but from what source these advantages are derived, does not appear to be so well understood. By the mechanical action of the roller, the various fluids, which occupy the different vessels and cells of the fruit, are mingled with the juices of the rind and seeds and with the macerated substance of the vessels and cells themselves. In such a mixture, it seems probable that new elective attractions will be exerted, and compounds formed, which did not exist previously to the fruit being placed under the roller: and hence the most correct analysis, of the expressed juices, will convey but a very imperfect degree of knowledge of the component parts of the different fluids, as they existed in their state of separation, within the fruit. I have often extracted, by means of a small hand-press, the juice of a single apple, without having previously bruised it to pieces; and I have always found the juice, thus obtained, to be pale, and thin, and extremely defective in richness, though the apple possessed great merit as a cider-fruit. I have then returned the expressed juice to the pulp, which I have repressed after it has been exposed, during a few hours, to the air and light; and the juice has then become deeply tinged, less fluid, and very rich. In the former state it apparently contained but a small portion of sugar: in the latter, it certainly contained a great quantity; much of which I believe to have been generated subsequently to the fruit having been subjected to the action of the press; though it may be difficult to explain satisfactorily the means by which it could have been produced. The component parts of sugar are well known: it consists of vital air,* inflammable air,† and charcoal.‡ The two latter substances are evidently component parts of the apple, and it appears possible that these, during the process of grinding, may absorb, and combine with, a portion of the vital air of the atmosphere. It is well known that vital air is absorbed by

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* Oxygen---Vital air supposed to be deprived of light and heat.

† Hydrogen.

‡ Carbon—Pure Charcoal, abstracted from all earthy and saline matter.

Barley, during its germination; and that a considerable portion of sugar, which did not previously exist in the barley, is then generated; and there can be no doubt, but that the vital air, then absorbed by the barley, afterwards exists as a component part of that sugar. Whether vital air be absorbed, with similar effects, by the juices of the apple, whilst under the roller, is a curious question for the investigation of the chemist; but it is sufficient for the cider-maker to know, that during the process of grinding his fruit slowly, with free access of air, the liquor he obtains, acquires good qualities, which it did not previously possess.

In the common cider-mill of Herefordshire, the fruit is reduced by a large circular stone, similar to those used for grinding corn, which is supported on its edge, and drawn round a circular stone trough by a horse. This engine is not without imperfections; but it is the best that has yet been, and perhaps, taking its merits in the aggregate, the best that ever will be, invented. I am convinced that Herefordshire has derived no small portion of its fame as the cider-county, from the judicious use of it's mill. Iron mills have been tried, but this metal is soluble in the acid of apples, to which it communicates a brown colour, and an unpleasant taste. The combination of the native acid of the apple, with lead, or its oxyds, forms an insoluble compound; and hence the deleterious qualities, which solutions of that metal always possess, will not be immediately communicated to the cider; because the metallic particles, by their greater specific gravity, will descend to the bottom of the cask. But if the liquor should become, in the smallest degree, acescent, as it usually does, before the cask is quite exhausted, the acetous acid will decompose the insoluble compound, and bring into action all the destructive qualities of the lead. This metal should therefore never be suffered to come into contact either with the fruit or liquor.

After the fruit has been thoroughly ground, the reduced pulp should remain twenty-four hours before it is taken to the press. If the fruit have been thoroughly ripe and mellow, a large quantity of the pulp will now pass through the hair-cloth, which is used in pressing, and as this will be thrown off in the first stages of fermentation, each cask, in which the liquor is placed to ferment, should want about a gallon of being full. Some advantages are found in the use of open vessels; but these can only be used under cover; and are therefore proper only where the quantity of liquor to be manufactured is small.

The fermentation of liquors has been divided into three stages; the vinous, the acetous, and the putrefactive. The first has been observed to take place in such bodies only, as contain a considerable portion of sugar; and it is always attended with the decomposition of that substance. The liquor gradually loses it's sweetness; acquires an intoxicating quality, and by distillation affords a greater or less quantity of ardent spirit, according to the quantity of sugar it originally contained, and the skill with which the process has been conducted. When this fermentation proceeds with too much rapidity, it is often confounded with the acetous; but the products of that are totally different. A violent degree of fermentation, however, tho' purely vinous, is extremely injurious to the strength and permanence of cider, owing to a part of the ardent spirit being discharged along with the disengaged air.

The acetous fermentation usually succeeds the vinous; but it will sometimes precede it, when the liquor is in small quantity, and exposes a large surface to the air. In this, vital air is absorbed from the atmosphere, and the ardent spirit, vegetable acid, and sugar, if any remain, are alike converted into vinegar.

The elaborate experiments of Lavoisier, have thrown much light on the elective attractions, which take place, and on the changes, which bodies undergo, during the progress of the vinous, and the acetious, fermentation. By these experiments it appears that the elementary principles of sugar, of ardent spirit, and of vinegar, are precisely the same; and that these substances, however opposite in their action on the palates and constitutions of animals, differ from each other only in the proportion of their component parts, and in the modes of their chemical union. I have already stated that sugar consists of vital air, inflammable air, and charcoal.* An increased proportion of inflammable air enters into the composition of ardent spirit, and of vital air into that of vinegar, and ardent spirit is easily reduced again into it's component parts, water and charcoal, with a minute portion of uncombined vital air.

In the putrefactive process, which follows the acetous, the vinegar loses it's acidity, becomes foul and viscid, and emits air of an offensive smell: an earthy sediment subsides, and the remaining liquid is little but water.

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* 100 pounds of sugar consists of--Hydrogen 8--Oxygen 64--Carbon 28.

The juice of the apple in it's unfermented state consists of sugar, vegetable mucilage, the malic acid, water, it's tinging matter, the principles of smell and flavour, of the tanning principle of astringency,* and of the gallic acid, I believe, in a very minute quantity. Of these component parts, the first only is known to be capable of producing ardent spirit, and it might thence be inferred that the strongest ciders would be afforded by the sweetest fruits: but the juice of these generally remains defective in what is termed "Body" in liquors, and it is extremely apt to pass from the saccharine to the acetous state. Much of the strength of cider is supposed by the Herefordshire farmers to be derived from the rind and seeds of the fruit; and hence arises their great attention to grind it thoroughly; the stalks also are necessarily reduced, when the

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* Some years previous to the appearance of the first edition of this Treatise, I had discovered that the astringent matter of the apple and pear had little, or no action, on sulphate of iron; and I thence expressed a doubt, in a note of that edition, whether the astringency of the apple and pear and of galls were of the same kind. A French chemist, Seguin, has discovered that there are two kinds of astringent matter; one of which combines with the substance of the skin of animals, and is the tanning principle, and the other the gallic acid: the latter, with the addition of sulphate of iron, forms ink. If a few drops of the juice of an apple or pear be added to a weak solution

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solution of glue, the tanning matter, which the juice contains, immediately combines with the glue, which becomes no longer soluble in water, and in consequence subsides to the bottom: the quantity of glue precipitated giving the quantity of tanning matter contained in any given portion of juice. Similar means have been used with success to ascertain the tanning power of different kinds of bark.

the apples are thoroughly ground; and the body of the liquor may possibly be strengthened, and it's flavour improved, by the astringent juice of these: yet it does not appear probable that either of these contains any saccharine matter.

The strongest ciders (and I believe the strongest wines) are made from fruits which possess some degree of astrigency; and this quality is so necessary in the pear, that I have never known a single instance in which perry, made from fruits that were without it, did not become sour before the middle of the succeeding summer. It may be preserved by a mixture of the harsh juice of the crab, and this, I imagine, is effected more by the astringent, than by the saccharine matter, the latter contains.*

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* I formerly conceived it probable that hops contained an astringent matter, which, like that of the apple

The period, which will elapse before the vinous fermentation takes place in the juice of the apple, is extremely uncertain. If the fruit be immature, and the weather warm, it will commence in less than twenty-four hours; but when the fruit has been thoroughly ripened, and the weather proves cold; it will remain a week, or fortnight, or longer, without the least apparent change; particularly in the juice of those fruits, which produce

apple and pear, would not become black by being mingled with a solution of sulphate of iron. But subsequent experiment, with solutions of glue, has perfectly satisfied me, that the hop contains very little astringent matter of any kind: and induced me to believe that it has derived it's character of preserving malt liquors more from having disguised and palliated acidity, than from having prevented it's existence. I have some reasons to believe that if a small portion of astringent matter, such as many kinds of bark would yield, were added to a moderate quantity of hops, malt liquors might be better preserved, and be rendered more agreeable to some palates, and more wholesome to some constitutions.

the strongest ciders. In the commencement of fermentation the dimensions of the liquor are enlarged, an intestine motion is observable in the cask, and bubbles of fixed air begin to rise and break on the surface. If the cask be placed in a vault, or other situation where there is but little change of temperature, the fermentation will generally proceed 'till the whole of the saccharine part is decomposed, and the liquor is become rough, and unpalatable to those unaccustomed to it in this state. But as ciders, which contain a considerable degree of sweetness, are most valuable, much attention is employed to prevent an excess of fermentation. This is usually done by placing the casks in the open air, which is much the most effectual method; or in sheds through which there is a free current of it, and by drawing off the liquor from one cask to another, and sometimes by exposing it to the air in flat shallow vessels, whenever the fermentation proceeds with too much rapidity. By the first of these means the liquor is kept cool, and it's decomposition is in consequence retarded; but the effect of racking off, unless the liquor be bright, does not appear to be so well ascertained. It is generally done with a view to cool it, but heat is rarely, or never, disengaged in the fermentation of cider; and the air through which it passes, when the operation is performed in the day, is usually several lines warmer than the body it is supposed to cool. Some degree of cold will, no doubt, be produced by evaporation; but never sufficient to produce the total suspension of fermentation, which takes place after the liquor has been drawn off from one cask to another. It no doubt gives out something, to, and may possibly receive something from, the atmospheric air; with which it can never have been properly in contact, having been always covered with a stratum of fixed air. This may at any time be proved by holding a lighted candle close to it's surface, where it will be immediately extinguished.

The progress of fermentation, if the weather be cool and settled, will generally become entirely suspended in a few days; and the liquor will then separate from it's impurities. Whatever is specifically lighter will rise to it's surface, whilst the heavier lees will descend to the bottom; leaving the intermediate liquid perfectly clear and bright. This must instantly be drawn off, and not suffered, on any account, again to mingle with it's lees; for these possess much the same properties as yeast, and would inevitably bring on a second fermentation. The best criterion to judge of the proper moment to rack off will be the brightness of the liquor; but this is always attended with external marks, which serve as guides to the cider-maker. The discharge of fixed air, which always attends the progress of fermentation, has entirely ceased; and a thick crust, formed of fragments of the reduced pulp, raised by the buoyant air it contains, is collected on the surface. The clear liquor being drawn off into another cask, the lees are put into small bags, similar to those used for jellies; through which whatever liquor the lees contain gradually filtrates, and becomes perfectly bright. It is then returned to that in the cask, in which it has the effect, in some measure, of preventing a second fermentation. It appears to have undergone a considerable change in the process of filtration. It's colour is remarkably deep; it's taste harsh, and flat, and it has a strong tendency to become acetous; probably by having given out fixed, and absorbed vital, air. Should it become acetous, which it will frequently do in forty-eight hours, it must not on any account be put into the cask. If the cider, after being racked off, remain bright and quiet, nothing more is to be done to it, 'till the succeeding spring; but if a scum collect on the surface, it must be immediately racked off into another cask; as this would produce bad effects, if suffered to sink. If a disposition to ferment with violence, again appear, it will be necessary to rack off from one cask to another, as often as a hissing noise is heard. The strength of cider is much reduced, by being frequently racked off; in part because a larger portion of sugar remains unchanged; which adds to the sweetness, at the expence of the other quality; and in some measure, probably, because a portion of ardent spirit escapes, whilst the liquor presents so large a surface to the air. The juice of those fruits, which, produce very strong ciders, often remains muddy during the whole winter; and much attention must frequently be paid to prevent an excess of fermentation. The smoke of sulphur is sometimes used, and bullock's blood to render it bright: the latter is a disgusting practice, and both are unnecessary, when the liquor has been made from good fruits, properly ripened.

Fermentation generally takes place so readily in the juices of the apple and pear, that the necessity of taking any measures to promote it very rarely occurs. I am nevertheless inclined to believe, that the addition of yeast, or of the residue which remains in the cask, from which cider has been racked off, (provided that cider be of good quality) will always be found beneficial, where the newly expressed juice seems disposed to remain quiet and muddy: because it will be advantageous to the cider-maker to promote an early commencement of fermentation in the autumn, that he may be able to render his liquor clear and bright, and to destroy all tendency in it to ferment, before the return of warm weather in the spring. This will be best effected by placing the casks in a situation where they are much exposed, during the autumn and winter, to moderate variations of temperature: for the disposition of liquors to ferment, like the irritability of animal and vegetable life, becomes gradually exhausted by being frequently excited into action.

The casks, into which the liquor is put whenever racked off, must always have been thoroughly scalded, and dried again; and each should want several gallons of being full, to expose a larger surface to the air, as long as the liquor shews any considerable tendency to ferment. Should the weather be uncommonly cold, a covering of straw will be necessary. In the end of March, or the beginning of April, the cider is generally fit to be taken from the hands of the manufacturer, and it should then be put into the casks in which it is to remain, and placed in the cellar, or other situation, where it is not much exposed to rapid changes of temperature. The casks are now to be filled entirely, and stopped as soon as all danger of further fermentation is over; which is supposed to be whenever a blue film begins to collect on the surface of the liquor. It will, however, be proper to put the bungs in somewhat earlier, to exclude the external air, and to prevent the rapid escape of fixed air, when a moderate quantity only is discharged; for it is by the union of this substance, with a certain portion of water, that ardent spirit is generated: but the bungs should not be driven in firmly, lest fermentation should recommence, and endanger the casks. A small quantity of spirit is sometimes added; and when scarcely any degree of fermentation has taken place, and the liquor in consequence retains nearly the taste of the unfermented juice, it may probably be used with advantage: but when that has fermented properly, it is always unnecessary; and I have sometimes known a renewed and violent fermentation produced by it, which has proved fatal to the liquor.

Ciders, which have been made from

good fruits, and have been properly manufactured, will retain a considerable portion of sweetness, in the cask, to the end of three or four years; but the saccharine part, on which alone their sweetness depends, gradually disappears; probably by a decomposition, and discharge of fixed air, similar to that which takes place in the earlier stages of their fermentation. Cider is generally in the best state to be put into the bottle at two years old; where it will soon become brisk and sparkling; and if it possess much richness, it will remain, with scarcely any sensible change, during twenty, or thirty years; or as long as the cork duly performs it's office.

In making cider for the common use of the farm-house, few of the foregoing rules are, or ought to be, attended to. The flavour of the liquor is here a secondary consideration with the farmer; whose first object must be to obtain a large quantity at a small expence. The common practice of the country is sufficiently well calculated to answer this purpose. The apples are usually ground as soon as they become moderately ripe, and the juice is either racked off once, as soon as it becomes bright, or more frequently conveyed from the press directly to the cellar. A violent fermentation soon commences, and continues 'till nearly the whole of the saccharine part is decomposed. The casks are filled up and stopped early in the succeeding spring, and no further attention is either paid, or required. The liquor thus prepared may be kept from two, to five, or six, years in the cask, according to it's strength. It is generally harsh and rough,* but rarely acetous, and in this state, I believe, it is usually supposed to be preferred by the farmers and peasantry. But this opinion is not well founded: they like it best when it possesses much strength with moderate richness, and when it is without any thing harsh, or sour, in it's flavour; but they will drink it, and to a most extraordinary excess, when it is really acetous. They will however acknowledge, when they offer that which is harsh and rough to a stranger, (and they are at all times ready to give such as they have, with great liberality) that the operation of swallowing it is rather a severe one; but they always assure him that it will do him good, if he can get it down. And indeed if we may judge from the wonderful quantities they drink without apparent injury, we may venture to pronounce it at least as wholesome, as any amongst the various kinds of malt-liquors.* It must however be admitted that the sweet flatulent liquor, which is generally sold out of the cider-counties, is far otherwise; for much of this, having become harsh, and even acetous, has been afterwards sweetened in the cellar of the merchant.

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* When it has become extremely thin and harsh by excess of fermentation, the addition of a small quantity of bruised wheat, or slices of toasted bread, or any other farinaceous substance, will much diminish it's disposition to become sour.

An inferior kind of liquor is made by macerating the reduced pulp, from which the cider has been pressed, in a small quantity of water, and regrinding it. The residue of three hogsheads of the latter, yields about one of the former, which may be kept till the next autumn, and usually supplies the place of cider in the farm-house, for all purposes except for the labourers in the harvest. It is generally fit to be drunk very soon after it is made, and though no attention is ever paid to it during it's fermentation, it often remains, 'till near the end of the succeeding summer, more palatable than the cider pressed from the same fruit.

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* I have been informed by several Medical Gentlemen of eminence, on whose judgment and veracity I can place the most perfect reliance, that they have found strong astringent ciders to produce nearly the same effects, in cases of putrid fever, as port wine. The tanning principle, which abounds in both liquors, and is not found in the peruvian bark, is probably the agent; and this in ciders might, by proper choice of fruits, be increased to almost any extent. The high price of port wine totally prohibits the use of it in sufficient quantities amongst the poorer classes, where putrid fevers are generally most prevalent; and thence any thing, which would supply it's place, at a small expence, would be a valuable acquisition to the materia medica.

After the reduced pulp of the apple, and of the pear, has been ground again with the addition of water, and repressed, it is usually thought by the Farmer to be of no value whatever as a manure; because it has been observed to be destructive of vegetation,

getation, when spread on the ground in it's recent state. But when I have added to it a considerable quantity of quick lime, and had it turned over three or four times, it has become, towards the end of the succeeding summer, a manure of no inconsiderable value. I imagine that its destructive effects on vegetation, when newly taken from the press, must arise from the small remaining portion of sugar and vegetable acid, it contained, having become acetous by the absorption of vital air.

The directions contained in the preceding pages will, I hope, be found sufficient to guide the inexperienced planter in the choice of proper kinds of fruit, in the manner of planting to advantage, and in the manufacture of his cider: and I have no doubt but that, by attending closely to those directions, he will be able to raise good orchards, and to make good ciders, in almost every soil, and in almost every district. The planter will, however, still have to ascertain what peculiar varieties attain the greatest state of perfection in the soil in which he plants, and what mixtures of those varieties will afford ciders of the greatest excellence. This knowledge can not be acquired by reading; it can only be gained by experience and observation; and therefore, without taking up more of the time of the Reader, I shall proceed to offer a few observations on the culture of the pear, and on the advantages which individuals, and the community, might derive from extensive plantations of that fruit, and of the apple.

THE experiments which I have made on the pear, have not been nearly so numerous as those on the apple, and have been confined to a single variety, the Teinton squash; but they have been fully sufficient to convince me, that the diseases of both chiefly arise from the debility of old age, and will be found equally incurable: Though the pear is more probably a naturalized, than an indigenous, fruit in this country, it is much more hardy than the apple, and may certainly be cultivated, in almost every part of England, with nearly as much success as in Herefordshire. Like the apple it grows with greatest luxuriance in strong deep soils, and in these the finest liquors are at present obtained from it; but it will flourish in every variety of soil,* where it is not incommoded with water. It's culture differs so little from that of the apple, that the same rules are in general equally applicable to both. It is most successfully propagated on stocks of it's own species, but it will succeed, in some degree, on those of the Quince, the Medlar, the Whitebeam, the common Service, and the Hawthorn; and probably on many others. When grafted on it's own seedling stocks, which alone I would recommend, the operation should always be performed near the ground, on account of the reclining topheavy growth of the young stocks. In raising stocks from the seeds of this fruit, a light and soft loamy soil should be chosen, which is naturally of good quality; but which has not been recently manured. In this, the seeds, like those of the crab-tree, should be covered about an inch deep, as soon as they are taken from the fruit.

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* If a penurious clay should be thy lot,
Or rough unwieldy earth, nor to the plough,
Nor to the cattle kind, with sandy stones
And gravel o'er abounding, think it not
Beneath thy toil; the sturdy pear-tree here
Will rise luxuriant, and with toughest root
Pierce the obstructing grit and restive marl.
PHILIPS.

Much attention must be paid to the young plants during the earlier part of the first summer, or great numbers will perish: they must be kept clear from weeds, and regularly watered in dry weather; and if the mould be frequently stirred between the plants, it will be of great advantage to them. After the middle of August, they become more hardy, and little care, or attention, will then be required from the planter.

A sufficient number of varieties of this fruit, in a good state of growth, are in cultivation; but few of them possess any high degree of merit. The greater part are extremely productive of juice, and require to be ground soon after they fall, or are blown from the trees. The produce of some of them, when it has been nicely manufactured, from well ripened fruit, often possesses great excellence; but it is often at the same time sweet, and acetous; and if, owing to an unfavourable season, the fruit have not been properly ripened, and an excess of fermentation cannot be prevented, the liquor becomes sour and unpalatable, and scarcely good enough to answer the meanest purposes of the farm-house.

I am much disposed to doubt whether a single perry-pear, possessing nearly the greatest degree of excellence of which this species of fruit is capable, has yet been in cultivation. It appears highly probable that firmer fruits, which might be kept some time, or left under the trees to attain a more perfect and regular maturity, are likely to afford a more permanent, and generous liquor. One pear, which in some degree answers this description, has been much cultivated, the Longland; and though it's produce, being without the fine flavour which is found in some others, is little attended to by the merchant, it has qualities which render it extremely valuable to the farmer: the fruit may be kept some time without sustaining any great degree of injury, when business of more importance occupies his attention: the liquor obtained from it is never very fine, but it is rarely below mediocrity: it possesses more body than is generally found in perry, and retains many of it's good qualities in every different soil and situation. It is a fruit I should strongly recommend for culture in cold and exposed situations, for which the hardiness of it's blossom renders it peculiarly well calculated; but I am afraid it is advancing nearly to that period when young trees can no longer be raised with advantage to the planter.

The pear is an extremely long-lived tree, and the same variety may in consequence be very long kept in cultivation. At what period the Teinton Squash first sprang from the seed, probably cannot now be at all ascertained; but I suspect, from it's present diseased and worn out state, that it existed at least as early as the beginning of the sixteenth century: for another kind, the Barland, which was much cultivated in the early part of the seventeenth century,

tury, still retains a large share of health and vigour; and the indentical trees which supplied the inhabitants of Herefordshire in the seventeenth century, with liquor, are likely to do the same good office to those of the nineteenth. I suspect, however, that this variety naturally possessed a greater degree of durability, than is common to the species; and that it's lofty aspiring growth, by rendering it difficult to get grafts from the extremities of the bearing branches, has in cultivation made it still more durable. It is yet capable of being propagated; but trees nearly of the same stature with those which now abound, must not again be expected. The tree, which is said to have been the original, grew in a field called the Barelands in the parish of Bosbury, and was blown down a few years ago.

Though I do not think very highly of any of the perry-pears which are now cultivated, I do not know that I can point out the means of acquiring better. Those which I have employed to obtain improved kinds of the apple, appear to me to be wholly improper. Almost every variety of that fruit, which possesses colour and richness, is capable of making fine cider, either alone, or in mixture with other kinds; but a good perry-pear requires an assemblage of qualities, which will be rarely found in the same fruit. It must contain a large portion of sugar, or it's juice can never possess sufficient strength; and unless it be at the same time extremely astringent, the liquor produced from it will be acetous, whenever it ceases to be saccharine. In the latter state it will agree with few constitutions, in the former with none. The juice of the best perry-pears is so harsh and rough, as to occasion a long continued heat and irritation in the throat, when the fruit is attempted to be eaten; yet in the process of grinding it becomes rich and sweet, without more roughness than is agreeable to almost every palate.*

The defects of the apple and pear, when raised from seed, are generally of opposite kinds: in the former the fruit is usually harsh and sour, in the latter it is apt to be, when thoroughly ripe, sweet and insipid. The mode of cultivation therefore which would improve the one by bringing it nearer to the highly cultivated state, and lessening it's harshness, would not improbably be injurious to the other by producing the same effects.

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* Vegetable juices in many instances undergo singular changes, when extracted. The root of the arum (wakerobin) is so extremely acrid as to occasion, when chewed, very considerable pain in the mouth for many hours afterwards: but the expressed juice, with the spirituous or watery extracts, scarcely partakes at all of the acrimony of the root, tho' this, like the pulp of the pear, will be rendered mild and tasteless. The acid juice of the Pine apple also loses almost the whole of it's flavour by being simply pressed from the pulp.

An estimate may, in some measure, be formed in the apple of the merit of the fruit by the leaf and growth of the seedling tree, but in the pear these scarcely afford the slightest indication of the future produce. The leaves of those plants which will afterwards afford large rich fruits for the desert, are often small and thin, and the stems will be covered with thorns; whilst others, whose leaves and growth shew every mark of a high state of cultivation, will sometimes produce fruits which are small and worthless.

I do not know that better means can be used in obtaining new varieties of this fruit, than sowing a large quantity of seeds from healthy trees of an orchard in which the best kinds only have been planted; and afterwards selecting the plants of the most luxuriant and vigorous growth. But as no estimate can be formed of the value of their future produce, it will be prudent to retain a considerable number 'till their fruits be known: few of which I am afraid must be expected to answer the wishes of the planter.

I have during the last fifteen years, examined a very large number of seedling-pears, and have a considerable variety growing in a farm I occupy; but I have never discovered more than one kind,* which I think capable of making fine perry. The greater part of these, however, appeared to me to have sprung from the seeds of rich eatable pears, and some of them bore a very close resemblance to the fruits of old grafted trees in the neighbouring orchards. I have in two instances only seen the fruit of seedling plants of which I was able to ascertain with certainty the parent tree. These were the offspring of a small pear, whose pulp is red; and the seedling plants inherited this peculiarity. The fruit of one of them is nearly like that of the parent tree, and that of the other is about the size of a winter burgamot, to which it is extremely similar; but it's pulp and juice are nearly similar in colour to those of a pale red raspberry. Both varieties are like the parent fruit, extremely sweet; but without much flavour.

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* This tree grows in a hedge on the estate of CHARLES COOK ESQ. of the Moor, in the parish of Holmore: a small cask of perry made of it's produce seventeen years ago, some of which still exists, possessed more strength and body, than I have found in any liquor afforded by the pear.

There is little reason to believe that the resemblance would have been less between the parent and the seedling fruit, had the former been eminent for the production of fine perry; and it therefore appears probable, that good new kinds may readily be obtained from the seeds of the best now cultivated. But even if few should be found capable of affording fine perry, the produce of all will be valuable to the farmer to mix with crabs, or apples which have been blown prematurely from the tree. The vapid sweetness of the juice of the pear is corrected by the acidity of these; and the liquor produced by the mixture often possesses much more merit, than could have been expected from the ingredients. It will perfectly supply the place of small beer, and may be brought into the market at less than half the price, with sufficient profit to the grower.

The time which seedling-trees will require to attain sufficient maturity to produce fruit, appears to vary much in different varieties. I have one plant which produced fruit at sixteen years old, another at eighteen, and another which, from the concurrent testimony of many old people, who remember it's first blossoms, appears to have remained unproductive through the first seventy years of it's existence. It has since borne well; but it's fruit is always without seeds, and with scarcely any internal cavity; and it appears to set with difficulty, much the greater part of the blossoms being constantly unproductive. Possibly it's long continued barrenness, and the defects in it's fructification, may both have arisen from some incidental imperfection in the organization of the plant. The fruit is in other respects perfect, and possesses great merit as an eatable pear.

The directions I have already given for planting the apple, are in every respect applicable to the pear; except that this tree, being of more luxuriant and lofty growth, will require wider intervals. In the most closely planted orchards, the rows should not be put at less than eighteen yards distance, nor the trees nearer than eight or nine from each other; and when the ground is to remain in tillage, intervals of twenty-five, or thirty yards, should be allowed between the rows. Attention must also be paid to the forms and stature of the different varieties, and trees of one kind only should occupy each row. In some kinds the fruit grows only on the outside of those branches which are exposed to the sun and air; in others it occupies every part of the tree: the former will of course require to be planted at greater distances than the latter.

The produce of the pear-tree, though of the same variety, and growing on the same stock, generally ripens extremely irregularly; and the planter must therefore have a considerable number of trees of each kind he plants, or he will rarely have a sufficient quantity ready to be ground at the same time. Even when the fruit has fallen spontaneously from the trees, a fourth at least of some kinds will be found immature, or decaying, and totally unfit to make fine perry; and should be (though it rarely or never is) separated from the rest.

To this want of perfect and regular maturity of the fruit, I am disposed to attribute a defect from which perry is seldom found entirely free. There is generally a crude and harsh acid in it, which dwells on the palate, and which justly offends the best judges of vinous liquors: and to this cause, perhaps, it may be attributed that perry, when genuine, does not agree with so many different constitutions as cider.

The pear requires a certain state of maturity to afford perry in the greatest state of perfection: it should be ripe without being mellow, or decaying. When it has not obtained the proper state of ripeness, an excess of fermentation cannot be prevented; and when it has exceeded it, the liquor rarely ferments kindly, and is extremely apt to become sour; probably by having lost too great a portion of its astringency: hence few kinds are found to improve by being kept after they have fallen from the trees.

Pruning is not often wanted in the culture of the pear-tree, which is rarely much incumbered with superfluous branches; but in some kinds whose form of growth resembles the apple-tree, it will sometimes be found beneficial. The observations I have already made on the latter, are, under similar circumstances, equally applicable to this tree.*

The blights of the pear, like those of the apple, arise either from insects, or unfavourable weather, or a combination of both; or from the attacks of parasitical plants. The blossoms are often rendered abortive, by a small brown beetle, precisely similar to that found on the apple-tree, and probably of the same species; and a considerable quantity of it's fruit is frequently destroyed by the larvæ of a small green four-winged fly. Each fruit which contains the latter insects becomes in a few days rounder than those in the natural state, and grows with much greater rapidity; but it falls off early in the summer, and if it be examined whilst growing, it will be found full of small grubs. The pear-tree suffers more frequently from cold than from insects, and therefore those varieties, whose blossoms are produced rather late in the spring, and are preceded by the leaves, are generally most productive of fruit: and some kinds of the pear, as of the apple, are much more subject to injury both from insects and unfavourable weather, than others. I have one seedling tree, whose blossoms appear capable of bearing the most unfavourable weather without injury; and which has not once failed to produce a good crop in the memory of the oldest inhabitant of the village in which it stands. The fruit is rather too sweet to be of much value, unless in mixture with other kinds, or to grind with apples which have fallen prematurely from the tree; but it nevertheless forms a very valuable variety for cold and exposed situations, as it ripens somewhat early in autumn.

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* The instrument, which is generally used in pruning the apple and pear-tree in Herefordshire, is formed like a large chisel, with a staff or handle about six feet long; by which the pruner is enabled to reach the extremities of the branches. This instrument has also an edge on one of its sides; so that it may occasionally be used as a light axe or bill; and on the side opposite the edge is a hook to draw away the small branches as they are cut off. It is an excellent instrument in skilful hands.

In the manufacture of perry the pears are ground and pressed precisely as apples are for cider: it is not, however, usual to suffer the reduced pulp to remain any time unpressed. It has never been a custom in Herefordshire, or the adjoining counties, to mingle the juices of different varieties of the pear, with a view to correct the defects of one kind by the opposite qualities of another. Yet it is certainly more easy to find the required portion of sugar, and of astringency and flavour, in three or four varieties than in one; and hence a judicious mixture of fruits affords a prospect of considerable advantages. In grinding, the pulp and rind of the pear, like those of the apple, should be perfectly reduced; and though no advantages are said to have been derived from the reduced pulp remaining some hours unpressed, I have no doubt but that, where all other circumstances are the same, that portion of liquor will generally be found the best, which has remained longest under the mill-stone. The juice of the pear, and of the apple, consist of the same component parts; but in different proportions. In the juice of the pear the tanning principle abounds, with a less portion of sugar, and of mucilage and tinging matter.

The management of perry during it's fermentation, is similar to that of cider; but it does not afford the same criterions by which the proper moment to rack off may be known. The thick scum, which collects on the surface of cider, rarely appears on the juice of the pear, and during the suspension of it's fermentation, the excessive brightness of the former liquor is seldom seen in this; but if the fruit have been regularly ripe, it's produce will generally become moderately clear and quiet in a few days after it is made, and it must then be drawn off from it's grosser lees. An excess of fermentation is prevented by the means used in the manufacture of cider, and the liquor is rendered bright by isinglass. The power this substance possesses, of fining liquors, has been supposed to be purely mechanical: it is composed of innumerable fibres, which being dispersed over the liquor, attach themselves to, and carry down, it's impurities. For this purpose it should be reduced to small fragments by being pounded in a mortar, and afterwards steeped twelve or fourteen hours in a quantity of liquor sufficient to produce its greatest degree of expansion. In this state it must be mixed with a few gallons of the liquor, and stirred 'till it is diffused and suspended in it; and it is then to be poured into the cask, and incorporated with the whole by continued agitation, for the space of two hours. This process must be repeated 'till the required degree of brightness is obtained, the liquor being each time drawn off, on the second or third day, from it's precipitated lees. Not more than an ounce and half, or two ounces of isinglass are, I believe, generally put into a cask of a hundred and ten gallons at once. Were the operation of isinglass, however, purely mechanical, there could be no objection to the use of a larger quantity; but it has also a chemical action on the liquor. It combines with, and carries down, the tanning principle, and hence, during the process of fining, the liquor loses a larger portion of it's astringency. Isinglass is most readily diffused in liquors by being boiled; but by this it is dissolved, and it's organization, on which it's powers of fining, in some measure, depend, is totally destroyed. The application of it is sometimes necessary in the manufacture of cider; but as it is rarely wanting in that liquor, I deferred inserting the directions for using it, 'till I came to speak of perry; which is seldom made thoroughly bright, or fit for the bottle, without it. When cider or perry can be made bright without the aid of isinglass, I would by no means recommend the use of it. The excessive brightness, which it produces, is extremely agreeable to the eye; but the liquor has always appeared to me to become more thin and acid by it's operation.

The after-management of perry is the same as that of cider; but it does not so well bear situations where it is exposed to much change of temperature, and it's future merit cannot so well be judged of by it's present state. In the bottle it almost always retains it's good qualities, and in that situation I would always recommend it to be put, if it remain sound and perfect at the conclusion of the first succeeding summer.

The pear, though it furnishes but an unpopular liquor, except in it's greatest state of perfection, possesses many advantages over the apple for general culture: it will flourish in a greater variety of soil, is much more productive, and being incapable, in those varieties which are proper for perry, of being eaten, or applied to any culinary purpose, it is little subject to be stolen in situations where fruits do not abound. As an ornamental tree, it possesses sufficient merit to entitle it to a place, where ornament is the principal object: it's form is often picturesque, and it's blossoms in the spring, and fruit in autumn, are always beautiful. Every tree, when nearly full-grown, in moderately good ground, will afford an annual produce (taking many years together) of more than twenty gallons of liquor, on the lowest computation, and an acre is capable of containing thirty at least of such trees; which, if of new varieties of fruit, will continue productive beyond the conclusion of a second, and perhaps of a third, century.

The produce of an acre, planted with apple-trees, will generally be found nearly one third less, than the same quantity of ground, planted with pear-trees, would afford: but the apple-tree begins to bear a good deal earlier, and cider will ever justly be preferred to the juice of the pear. As an object of sight, the pear-tree has every advantage over it's rival; and it must be admitted that nothing can be more ugly than an apple-tree, such as we too often see it. It's ugliness, however, arises not from natural deformity, but from the effects of debility and disease: and these no more necessarily belong to the apple-tree, than to the Oak and Beech: and I am not without hopes that the early foliage, and colour of the fruit, of some varieties, which I have propagated between the most beautiful of our apples, and the Siberian crabs, may in some degree deserve a place as trees of ornament, as well as of use.

The value of the ground, as a pasture, in closely planted orchards, will necessarily be much reduced; but the loss of herbage will in few instances amount to more than one tenth of the value of the fruit. The grass an orchard produces, comes very early in the spring, when it is peculiarly valuable to the farmer; and when under judicious management it is never suffered to grow long or coarse; an orchard will be found to support a very considerable quantity of stock. It also not unfrequently happens that the same ground, which produces but a very small portion of herbage, will make an excellent orchard. I have one of this kind, which has, during the last thirty years, afforded a produce of little, if any thing, less, than four hundred gallons an acre; and I am certain that, if the trees were wholly taken away, the same acre would not support two small sheep, throughout the year, without difficulty: yet the whole of the trees are, by no means, of the most productive varieties, which could be obtained. The soil is a deep stiff clay, somewhat indurated; and the field would be certainly less worth twelve shillings an acre, as a pasture, than it is worth three pounds an acre, as an orchard. Great Britain contains many hundred thousand acres capable of being as much improved by planting, as this ground has been; and the improvement might be made at an extremely small expence,* and within a short period of time. The experiment might easily be made, in any county, with the apple, on a single acre of ground, and within seven or eight years. If the stocks were to be raised from the seeds of the crab, and afterwards planted in the nursery, in rows six feet distant from each other, and with intervals of one yard between each plant in the row; an acre would contain just two thousand four hundred and twenty trees; and if these were to be grafted with varieties properly selected, at three years old, a quantity of apples would be afforded, by those grafts, in the fourth or fifth year, whilst in the nursery, sufficient to ascertain the merits of the soil; and the fruit might be sufficiently reduced, without the aid of a mill, to prove, in some degree, the qualities of the cider.

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* The natural value of an apple-tree, between five and seven feet high, is about three half-pence. I should have no objection to furnish twenty thousand at that price, as soon as they could be raised. A pear-tree of the same height, from the difficulty of raising the seedling stocks, can not be afforded for much less than three-pence, with fair profit to the nursery-man.

An opinion, I know, very generally prevails, that fine cider and perry cannot be produced, except in particular soils:* but this is certainly a vulgar error; and every soil, in which the fruit attains a perfect state of maturity, is capable of producing those liquors in a very considerable state of perfection.

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* The planters of Herefordshire, in the seventeenth century, conceived that fine ciders could only be obtained from light sandy soils, such as are usually termed rye-lands; and PHILIPS directs the farmer to

-----------Look, where full eared sheaves of rye
Grow wavy on the tilth, that soil select
For apples.

Both the apple, and pear, are found quite as highly flavoured, and as perfect, in many other counties, as in Herefordshire; and were the planter at liberty to choose his soil, I believe a loam of moderate depth, with a sub-soil of chalk, would be found at least equal to any, which the best parts of those counties, in which orchards now abound, could supply.

Were the apple and pear-tree thinly dispersed over the meadows and pastures, of every district, in which they would succeed, the injury done to the herbage would be extremely small; and such trees might easily be made to supply the whole of the population of the country, employed in agriculture, with as wholesome, and as palatable a beverage, as they now possess; and in fruitful years a large quantity would be afforded for the use of the towns. The number of acres now employed in raising hops, and poles to support them, might be greatly reduced; and this alone would be an immense advantage to agriculture. This plant at present occupies the best ground, which the farmer has to give it; it takes his best manure, and is too often the principal object of his attention; and, whilst it's culture ruins the crops of corn, in every district, where it abounds, it may be questioned whether the produce of a thousand acres annually afford nutriment enough to support a single human being. By the extended culture of the apple and pear, many millions of bushels of barley, now converted into malt, might annually be saved, and applied to better purposes; or the ground, now employed in it's culture, might be made to produce wheat, or other articles immediately necessary to society: and that the juice of the apple and pear will afford as wholesome a liquor* as any obtained from malt, the general appearance of the natives of the cider counties sufficiently testifies.

The result of the experiments, which I have related in the former part of these observations, will, I hope, be sufficient to

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* The large quantity of vegetable acid, which most ciders contain, will, however, disagree with some constitutions, which have not been accustomed to it: but this quantity of acid is, by no means, a necessary component part of that liquor. Many varieties of the apple are sweet and bitter; and I have some new varieties of this kind, apparently capable of making rich ciders, which appear to the taste to be totally without any portion of acidity. The ciders, which such fruits yield, are probably the most wholesome; and those, which in a considerable degree approach this character, are preferred by a large portion of the inhabitants of cider countries. The introduction of cider and perry into those districts, in which nephritic complaints abound, would probably be attended with the happiest effects; for, diseases of this kind are scarcely, if at all known, in the cider counties, to those who do not frequently use other liquors.

induce the planter to proceed with caution in every attempt to cultivate the old* fruits; under which name I include every variety, of which a single old and decayed tree can any where be discovered. A graft, taken from a bearing branch of a tree in this state, carries with it the habits and diseases of that branch, and can never form what can with propriety be called a young tree: it will be the continuation of an old one, and each plant will form an unnatural union of youth and age, of the living and the dead.

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* I would wish to guard the inexperienced planter against trusting to the assertions of nursery-men, particularly some in the neighbourhood of London; who will promise to send him trees of the Golden Pippin, or of any other kind of apple, that will not canker. But they are much in the habit of promising what they cannot perform, and are extremely ignorant of every thing beyond the mere routine of their profession; and (as usually happens) positive in proportion as they are ignorant. The insect, which has produced such destructive effects on the apple-trees, round London, during the last ten years, is said to have lately become less abundant; but apple-trees should on no account be taken from districts, where this destructive insect exists, into others where it is not known.

Much, I will allow, may be expected from the choice of proper soil and situation, and from the judicious use of manure; and something, perhaps, from topical application to external disease; but there is an inborn vigour in youth, pervading the whole of nature's organized productions, the loss of which, neither climate, nor food, nor medicine, can supply.

To the Herefordshire planters, it is wholly unnecessary to point out the futility of attempting to propagate the old fruits. Experience has perfectly satisfied them that it is impracticable; and they have paid, and are still paying, dearly for the knowledge they have acquired. And to the man of science, who is enabled to take a more extensive view of the objects around him, and to compare vegetable with animal life, there can surely be no occasion to urge the probability that both are subject to similar laws. A tree, like an animal, has it's infancy, it's "flowery Spring," it's "Summer's ardent strength," it's "sober Autumn fading into age," and it's "pale concluding Winter:" and nothing surely can be more unphilosophical than to suppose that a piece of an old dying tree can ever form a healthy and vigorous young one.*

But though my own efforts, as well as those of every other planter, with whom I am acquainted, have been totally unsuccessful, I am far from wishing to discourage any experiments in the nursery, or garden. I would, however, strongly recommend it to every man, who plants an orchard, to choose those kinds of fruit only, of which he knows the first, original tree to exist in health and vigour; for he will certainly see every one he plants affected by the age and state of the original tree;* as I have already remarked. The merits of some of the old fruits were certainly very great; particularly if we compare them with the execrable trash, which, under the name of new fruits, at present encumbers and disgraces the Herefordshire orchard. But new varieties, of equal excellence with the best of the old ones, in their better days, may readily be obtained;* and if these be judiciously adapted to different soils and situations, and

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* From the account which Sir G. STAUNTON has given of the method of making the kind of dwarf trees high in estimation in China, it appears that the Chinese have long been sensible of the difference between a young tree, and a part of the detached bearing branch of an old one, which has emitted roots.

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* It is contended by DR. DARWIN, in his *Phytologia*, (and much deference is certainly due to his great talents and extensive information) that each bud is a separate plant, the viviparous offspring of a bud of the preceding season; and that it receives it's nutriment immediately from the ground through radicles of it's own, which descend through the inner bark; and that, on this account, an inserted bud or graft can not decay from age. The narrow limits, and the subject of the present Work, do not permit me to enter at large into this question; and

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and I shall therefore only remark, that if the inner bark, and annual layer of wood, were, as he supposes, formed by radicles descending from the buds above, the stock must ultimately become covered with wood similar to that of the graft, by being formed of the radicles of it's buds: but the wood and bark of the graft never descend a single line below the original point of junction.

* My nursery contains at present a considerable number of tolerably good new varieties of the apple; to which every year makes an addition; and I shall be glad to make them as extensively useful as I can. The present year will afford me an opportunity of observing, in two instances, the success of my endeavours to combine the good qualities of different varieties, by introducing the farina of one kind into the blossom of the other. The appearance of one of the new varieties promises every thing I could wish.

and proper use be made of the advantage of having fruits, which blossom at different times, I am confident that the same number of acres, which are now planted with apple-trees, will afford at least four times the quantity of cider now produced, and of superior quality; and that a total failure of fruit, or any thing approaching to one, will rarely or never occur.*

I cannot

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* In situations too cold and exposed for the comparatively tender blossoms of the cultivated apple, seedling plants from the native, or yellow Siberian crab, would probably be found to succeed perfectly well, and might be planted with much advantage. The juice of these would differ from that of the apple only in containing less sugar with more acid and astringency; and hence, with the addition of sugar and water, it would afford a liquor perfectly similar to cider, at a lower price than beer will ever be obtained: and I see no reason why the sugar required might not be obtained from malt. The Welsh produce a highly intoxicating liquor by macerating the acid and astringent berries of the mountain Ash (Sorbus aucuparia) in water, and sweetening it with Honey.

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I cannot dismiss the subject without offering some apology for the imperfections of the foregoing treatise. The experiments, which have given existence to it; have of necessity occupied much the greater part of twenty years, though they have required very little skill, or industry, at any one time. Ten years more must elapse before the result of others I have made can be known; and I have in consequence been often able to give an opinion only, were I wished to have spoken from experience. But I have carefully separated what I know, from what I think, and my facts, I am certain, are correct. Those alone will, I believe, afford some information to the common planter, and will, I hope

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This liquor was perhaps anciently known to the savage inhabitants of Europe, and may be the same that Virgil has described in his Scythian Winter:

———————et pocula læti
Fermento atque acidis imitantur vitea sorbis.

hope serve to stimulate the inquiries of others. At a future time it may be in my power to offer a more perfect treatise. The subject is certainly interesting to the gardener and farmer, and there are parts of it, which appear to me, not wholly undeserving the attention of the naturalist.

FINIS

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POSTSCRIPT.

IT appears to me probable that the inspissated juice of the apple and pear might be used with great advantage in long voyages. I have frequently reduced it, by boiling, to the consistence of a weak jelly; and in this state it has remained seven years without the slightest apparent change; though it has been intentionally exposed to much variation of temperature. A large quantity of the inspissated juice would occupy but a very small space, and the addition of a few pounds of it to a hogshead of water, would probably at any time form a liquor a good deal similar to cider or perry: it might also be used to supply the place of rob of Lemons and Oranges, and might be obtained at a much lower price.

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